AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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The Watts-Campbell Company's Engines at the Fall River Iron Company's Works.

In the beginning it is proper to state that the name of the works mentioned above is a misnomer, the works named, so far as we know, never having made any iron, but, being one of the large cotton manufacturing concerns of New England. How the name originated, we are not informed.

The economy of manufacture of cotton goods in New England has come from years of competition with British manufacturers, and has been started from the right end, viz.: the motive-power department. Years ago when Corliss projected his automatic cut-off engine into the world of motive power, he found an opening for it in the Eastern cotton mills. The saving in coal which he could promise, assured his success from the beginning. It costs a good deal of power to get at the work, so to speak, in a cotton mill, and the room for saving is naturally great.

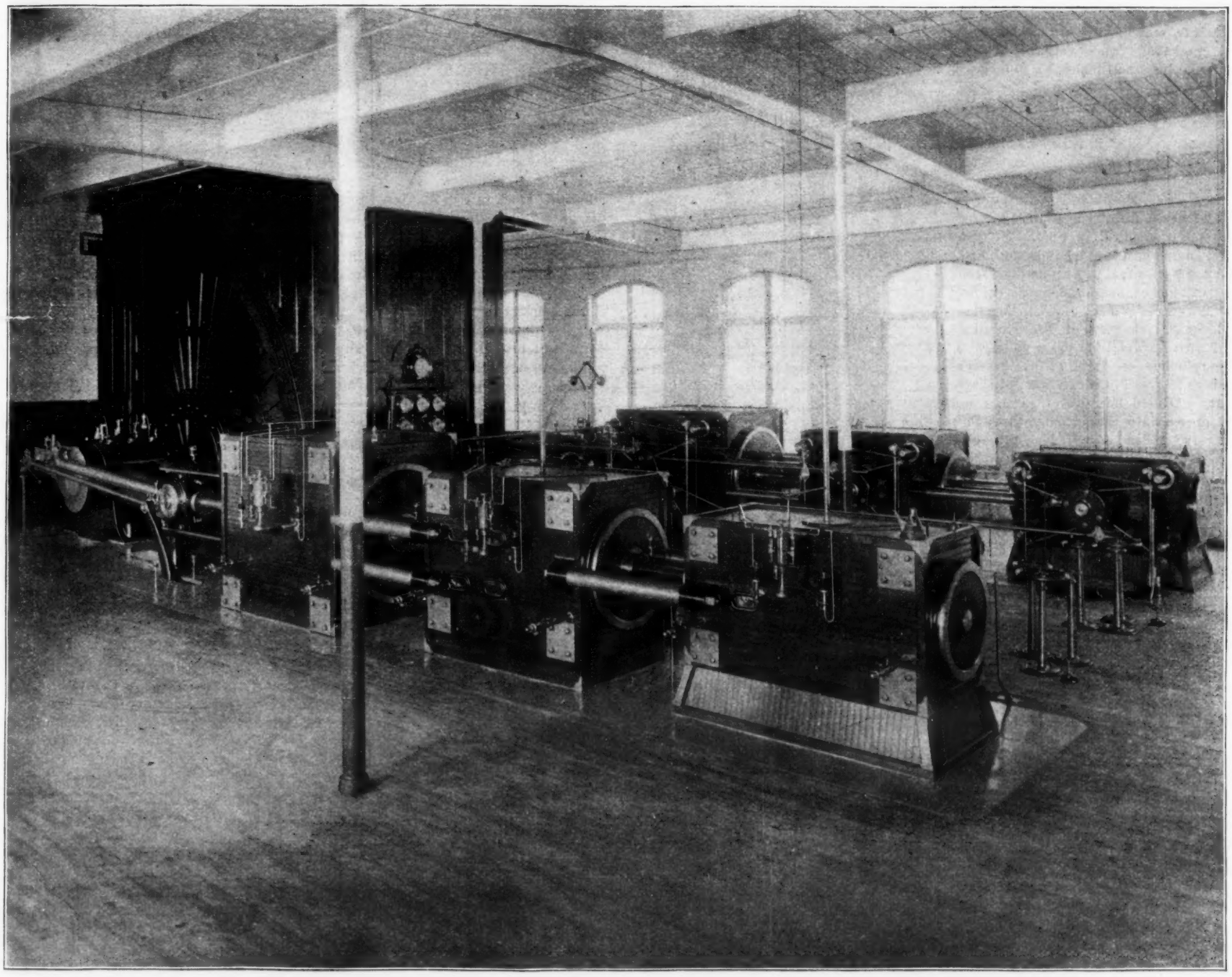
Later on came the compound engine which, offering a further saving of coal, was, after a time, accepted. It was not, as it had been in England, the patching up of the power by the addition of another cylinder, but the adoption of compounding by the use of two cylinders from the start. Finally, from knowledge gained mainly from marine engineering has come the use of triple-expansion engines for cotton mill work. There had been a considerable fight against two-cylinder compounds, but there seems to be little trouble in the introduction of three-cylinder compounds. The present illustration is of the twin triple expansion engines built for the works previously named, by the Watts-Campbell Co., of Newark, N. J.

The engines referred to, and shown in the engraving, each have cylinders 21 inches, 32 inches and 48 inches diameter, with a stroke of 60 inches, the speed being 65 revolutions and the rated horse-power 2,000. The engines, with some exceptions that will be noted, are of the Corliss type with the modifications that have been introduced by the Watts-Campbell Company. The fly-wheel, which is encased as is the practice in Fall River cotton mills, is 28 feet in diameter and 12½-foot face, and apparently runs as true as a lathe spindle. It is built up in segments, according to the practice of this company, there being, we believe, 24 arms. Four belts lead from this wheel at different angles to different rooms in the mill. The weight of the fly-wheel is 174,000 pounds. The main shaft is 22 inches diameter at the swell, and the main journals are 19 inches by 38 inches.

We have referred to some little difference between the valve motion of this engine and the motion more commonly employed by this company. This difference consists mainly in the employment of an additional eccentric for operating the exhaust valves of the low-pressure cylinders. This provides, amongst other things, for controlling compression in all three cylinders. That no complication may arise in starting the engine the cylinders are provided with by-pass valves that will take care of the exhaust while starting.

The engines stand 24 feet 1½ inches center to center, and in order that the heavy or "swell" part of the shaft shall approach the main journals as near as possible the bottom slides of the main bearings are made in two parts, longitudinally, which permits of their removal in half the space that would otherwise be required.

The eccentrics are also made in halves, so that they can be readily removed from the shaft, and in their construction what we consider a very important detail is in-



THE WATTS CAMPBELL COMPANY'S ENGINES AT THE FALL RIVER IRON COMPANY'S WORKS.

volved. As is well known, the light part of an eccentric is made thin in order to keep the diameter as small as is practicable. When such an eccentric is fastened to the shaft, either by set-screws or keys, the eccentric, as a whole, is thrown out of round, and then comes the inevitable heating until the surfaces get down to their bearing, which may not be for some weeks or months. In this engine the heavy part of the eccentric is bolted, by tap bolts, to the shaft, the eccentric being slotted to provide for the adjustment that may be required. Then to this heavy part the light part is made fast, having been previously bored materially larger than the shaft, so that it does not touch it. It is unnecessary to say that under these conditions there will be no springing of the eccentric. It should, perhaps, be said that this particular construction and fastening of eccentric is patented by John Young, the superintendent of the works. It is a neat, and, we think, an important arrangement.

As we have previously stated, the main features of the valve motion are the same as employed by the Watts-Campbell Company in their ordinary construction. Each engine is provided with its own air pump, driven by a return connecting rod in a manner quite common with engines of the Corliss type.

The total weight of the engine is 245 tons, the heaviest single piece being the main shaft, which, with attached pulley, hubs, cranks and pins weighed 31 tons. The crank-pins are 9½ inches by 10 inches.

The Charter Gasoline Engine.

With this we give illustrations of a horizontal gasoline or gas engine, and a new vertical engine of the same type. As will be seen, they are simple and compact in design, and we are informed they are very reliable and economical in operation. The vertical engine is one of 1¼ indicated, or 1¼ actual horse-power; it takes up a floor space of 24 by 22 inches, height 36 inches, driving pulley 8 inches diameter and 3 inches face. It is designed for a speed of 350 revolutions per minute; its weight is 400 pounds.

The principle of operation of these engines is as follows: On the first out-stroke of piston a diluted mixture of gasoline and air is drawn into the cylinder through a check valve on head of cylinder; this valve is closed during the in-stroke of piston. The mixture previously drawn into the cylinder is compressed into the space between head of cylinder and the piston during its in stroke. The carbon of the mixture is ignited by a device which simply consists of a short iron tube closed at the outer end and communicating with the interior of the cylinder, inclosed by a chimney and heated by a Bunsen burner. When the piston has reached its second out-stroke the exhaust, controlled by a cam movement, is opened and remains open during the second in-stroke of the piston and the products of combustion are expelled into the exhaust port, and from it conducted to the outer air.

The governor, which is within the pulley, gives only as much gasoline, and at the right time, as is needed to do the work; consequently the amount used depends on the work done. When less than full work is done, only as many charges of gasoline are admitted and ignited as are needed to keep up the regular speed of engine. When this speed is exceeded the governor does not give gasoline; but when the engine is working to its full capacity the governor gives a charge at each working stroke. A steady motion under a part or full load is obtained by the momentum of the fly-wheels.

The oilers are automatic and need attention only when they are to be supplied with oil.

The engines are well adapted for running dynamos, pumps, elevators, mills, saws, etc. Manufactured gas or, gasoline may be used. They are manufactured on the interchangeable system, so that all parts can be duplicated, by the Charter Gas Engine Co., 9 and 11 Wallace street, Sterling, Ill.

Universal Milling Machine.

The accompanying illustration is of a universal milling machine of the same general design, but somewhat larger and heavier than the machine heretofore built by the makers, the Garvin Machine Co., New York.

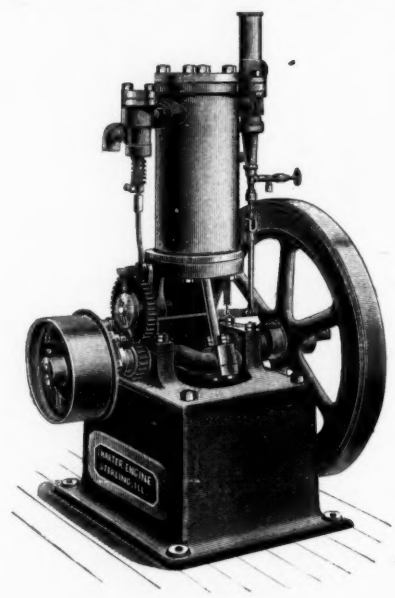
Being intended for heavier work, back gears are employed, and the entire machine has been strengthened to correspond with the increased driving power.

In accordance with modern practice, the entire column, including the uprights for overhanging arm and the bridge connecting them, is cast in one piece.

The arm is large and rigid, is clamped over both bearings, and can very readily be removed.

The outer end of arm is provided with a cylindrical bearing for the arbor, which is hardened and ground and supports the arbor firmly while yet allowing free expansion of arbor endwise.

Spindle is of steel, of large diameter, has the front bearing tapered, and the end thrust is taken by hardened and ground anti-friction washers. Both journals are finished by grinding and run in bronze boxes, having facilities for taking up wear and self oiling devices. The front end is



threaded for a universal chuck, which is interchangeable with the spiral head, and the rear end carries the feed cone. The arbor is drawn into, and removed from, the spindle by means of a shouldered screw fixed in the rear end of the spindle, and engaging the rear end of the arbor.

The table is wide and long, has a bearing over half its length in the swivel block, and a T-slot extending the entire length, accessible at both ends. It has vertical and lateral adjustments to thousandths of an inch, and can be swiveled 45 degrees either way from a straight position on the graduated base, and firmly bound by bolts at the ends of the swivel block.

The feed mechanism is not carried by the table, but is attached to the swiveling block; is self-adjusting, and allows the table to operate by power, with perfect freedom at any angle, up to 45 degrees either way. It will trip automatically at any point, with the table running in either direction.

The upper feed cone is provided with change gears, which can be instantly changed, giving twelve feed changes; and reverse feed is obtained by providing an extra step on the lower cone, and arranging it to slide on its shaft, to admit of crossing the feed belt.

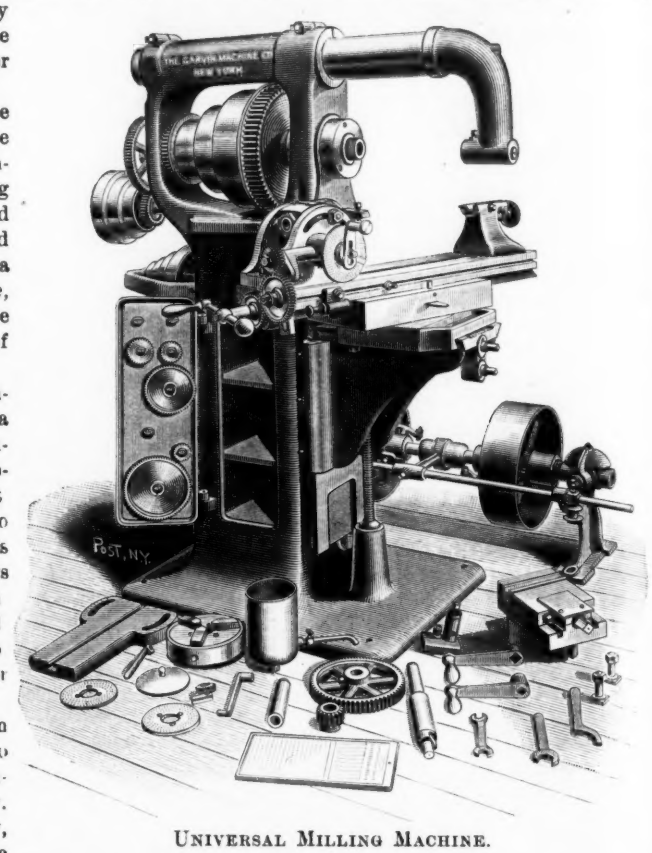
The feed screw is entirely protected, has a dial reading to thousandths of an inch, is provided with a compensating nut in the table to allow for wear, and is arranged to take gears for either simple or compound trains. All shoulders on screws are provided with means for taking up wear.

The spiral head has an extended base and two holding-down bolts, insuring great solidity. The spindle is hollow, admitting stock of large diameter. The taper hole is the same as that in the main spindle, both having a standard taper of one-half inch per foot, allowing an interchange of tools. It is also fitted with a universal three-jawed chuck, and the dividing worm gear is provided with a compensating wedge, which permits of instant adjustment of any slack in the worm. Three index plates are provided, giving all divisions up to 50, and, except a few prime numbers, all up to 360. The gearing is designed to cut a large number of spirals of even pitch, as one turn in 1½, 2, 2½ and 3 inches, etc. The manner of adjusting is very convenient, and the entire range of spirals from one turn in 1.33 inches to 133.33, are cut with a set of but eight change gears. A plate is provided, so that the spiral head can be set at any angle in line with the main spindle.

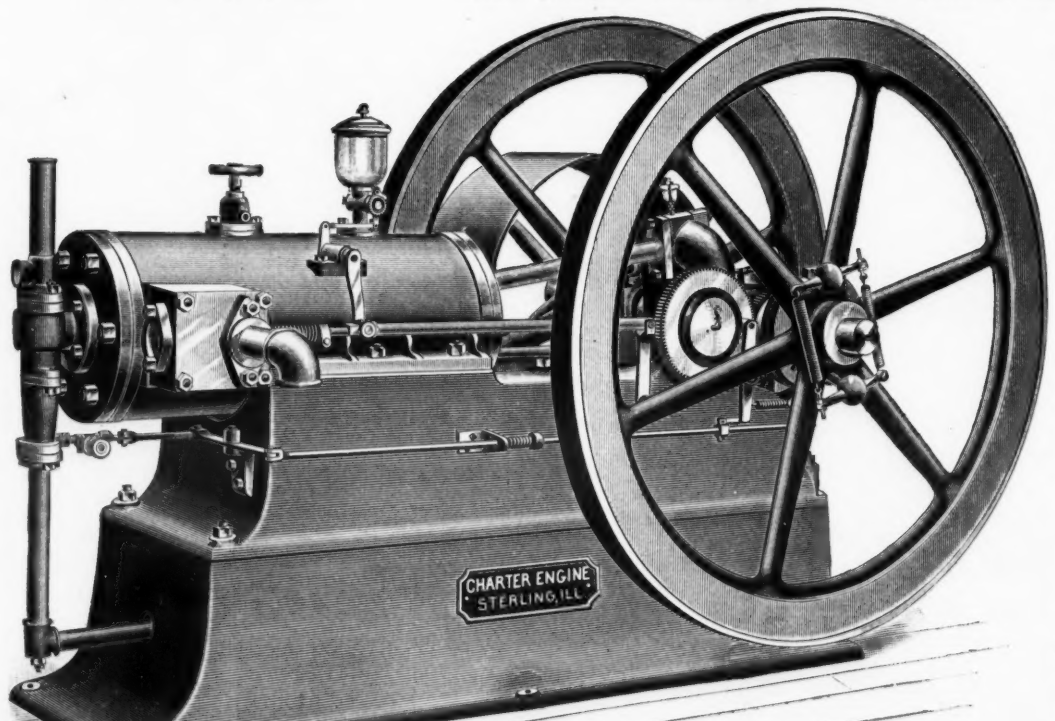
The tail-stock is of improved form, of solid design, and the spindle is bound its whole length without throwing out of line. The point is close to the top, enabling cuts to be taken close to the center.

The swivel vise furnished has the screw protected from chips and dirt, and allows cuts of any angle to be made with facility.

The principal dimensions are: Length of table, 34 inches; length of automatic feed, 21 inches; vertical range, 23 inches; swing of centers, 10½ inches; distance between centers, 20 inches; weight about 1,950 pounds.



Universal Milling Machine.



Charter Gasoline Engines.

Some Modern Printing Presses.

As illustrating the development of the modern printing press, we give some particulars regarding a press recently completed by Messrs. R. Hoe & Co., of New York, for the Phelps Publishing Co, of Springfield, Mass. This press is particularly designed for printing such publications as technical journals and others, especially those which have covers on them. It prints two sizes of pages, one twice as large as the other, and prints the large size from a web or roll at the rate of 20,000 copies per hour. These may be either 4, 6, 8, or 12 pages. In addition to merely printing these papers, they are folded, placed together in proper order, wired or pasted, and a cover of different colored paper pasted upon them, the papers being entirely completed as they issue from the press.

They are building also a press for the New York *Herald*, which will print a sheet in black ink, as usual, upon one side, while upon the other it prints four colors, and will do this at the rate of 20,000 4 page papers per hour. It not only prints, but also inserts the pages together properly, pastes them in place, and counts the papers in bundles of any desired number.

A Compound Verdict.

A jury in the U. S. Circuit Court, at Cleveland, O., has rendered a verdict in the suit of Fielding & Platt, of England, against the Morgan Engineering Co., of Alliance, O. The suit was for payment of $5 000 for machinery bought by the Morgan Engi

neering Co. of Fielding & Platt, machinery which, we understand, was installed at the Juniata shops of the Pennsylvania road.

The jury allowed Fielding & Platt $5,292.54, but also allowed the Morgan Engineering Company $10,518.59 on a counter-claim of $20,000. The trial was a very long one, and it is said that the case is not yet finally settled.

Buffalo Steel Plate Fans.

The "Steel Plate Fans," a type of which is illustrated by the accompanying engravings, are designed primarily to deliver a maximum volume of air with a minimum expenditure of power. In working out this design a very large number of experiments extending over a period of years have been made to determine the best possible proportion and design of inlet and outlet, scroll, etc., and it is believed that the result is a fan of exceptionally high efficiency.

These fans are constructed of steel plate with very heavy foundation frames, and the sides are stayed and stiffened by angle irons as shown. While the cut appearing illustrates an exhauster, which is a fan with only one inlet, and opposite the pulley side, these machines are as frequently built as blowers with two inlets. The steel plate fans, while largely employed for heating and ventilating work, are also used as blowers in rolling-mills, and, under such conditions, are built extra heavy.

These fans are regularly built both right or left hand, and to deliver air in any of the following forms: Bottom horizontal, top horizontal, up blast and down blast. They may be readily furnished in all sizes to discharge in any one or two angles to suit all conditions of application. The manufacturers are the Buffalo Forge Company, Buffalo, N. Y.

Twenty-four-inch Shaper.

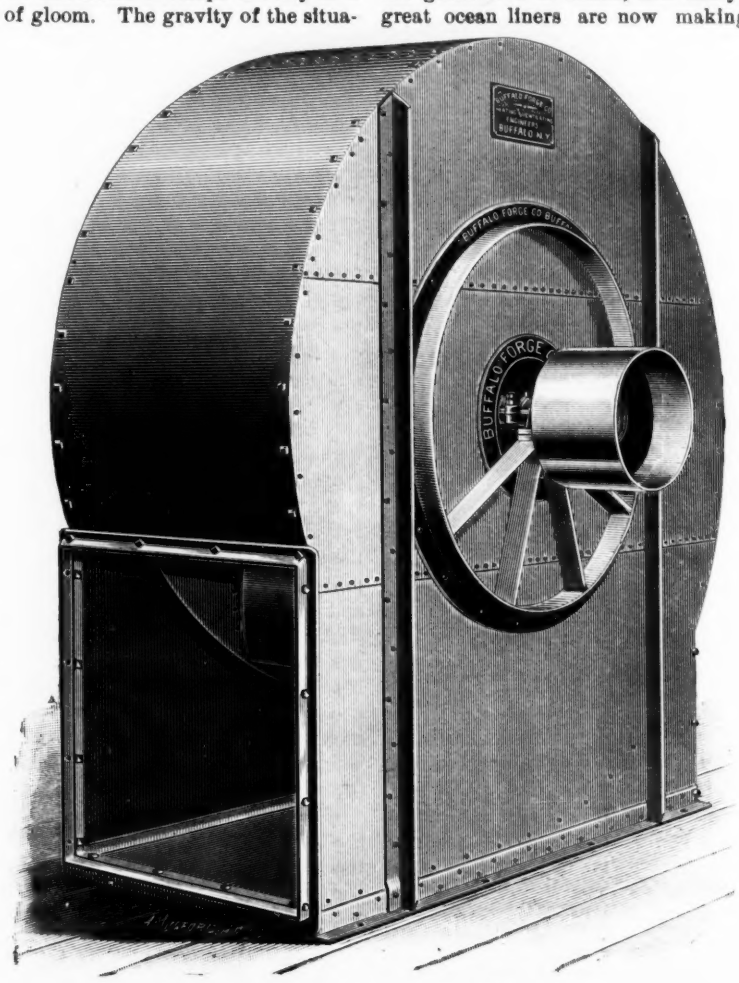
We present herewith two views of a 24-inch shaper made by the Hendey Machine Co., of Torrington, Conn.

The machine has a stroke of 24 inches, a cross-feed of 23 inches, and will plane a piece 18 inches high. It has a power-feed in all directions, the feed in the head being operated by a friction device, and cannot by any means injure itself if brought into contact with the work.

The machine is provided with a locking device for holding the friction wheels to their work when in operation, thus making it as positive in its action as a crank machine. It also has a micrometer adjustment on the shipper handle to use in setting the stroke of the machine to plane to a line, or into a hole. This will be found a very great convenience on tool or die work, for which the machine is in particular adapted.

The vise is of an improved pattern. The base is a graduated ring in which the vise sets, and which can be set to any angle desired.

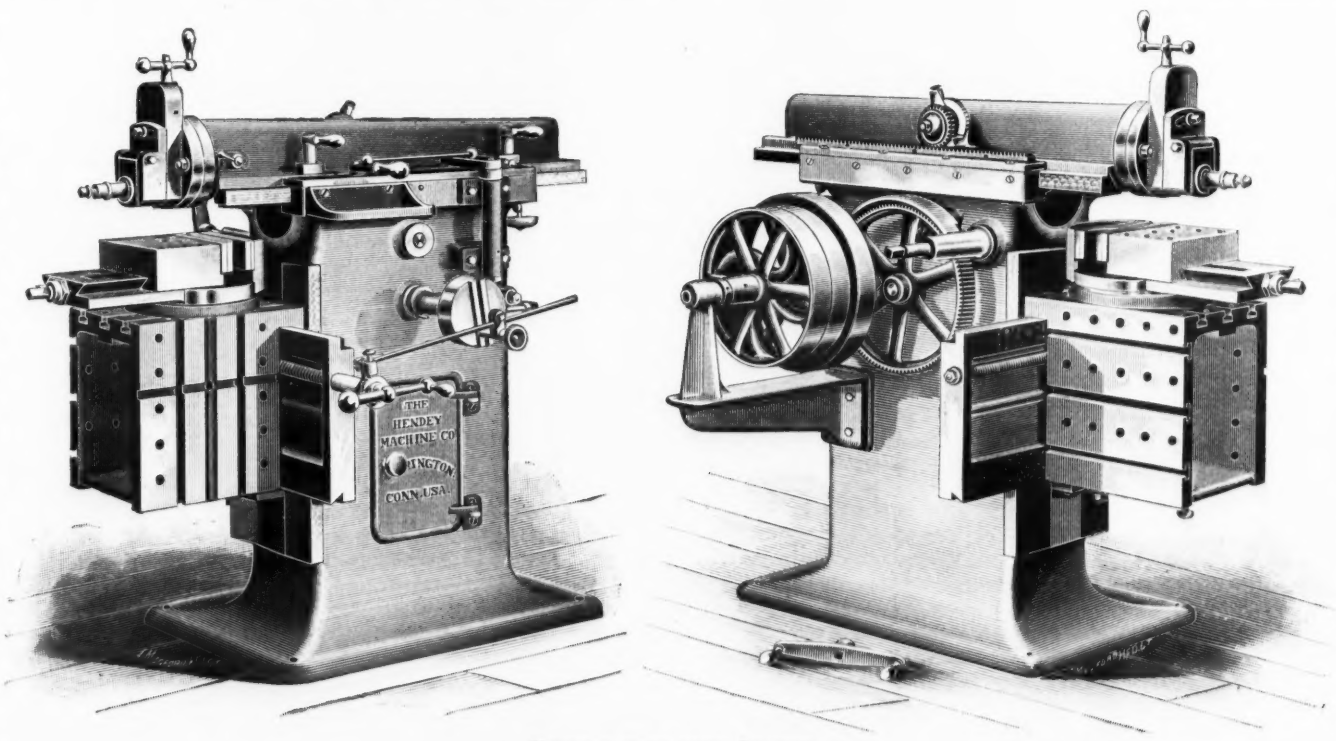
The vise may also be fastened on the side of the table for planing vertical work if desired. A space is provided under the cutter bar for passing a bar or shaft through, 8¼ inches diameter. The table and crosshead are very heavy and solid, and a clamping device is provided to fasten the table and crosshead together when the machine is cutting down, to keep the table from moving while under the cut. The weight of the machine is 2,400 pounds.



BUFFALO STEEL PLATE FAN.

Coal Exportation.

There is a great field for American anthracite in London. The major portion of the coal consumed in the metropolis is not only bad—it is absolutely vile. It emits dense masses of sulphurous smoke and fills the atmosphere, already heavily laden with misty dampness, with a burden it cannot dispose of and hence envelops the city in a shroud of gloom. The gravity of the situation to the specific nature of coal, with the result that the value—nay, the superiority of the American product, is inviting consideration. With reasonably careful firing it is universally acknowledged that both American hard and soft coal will emit, comparatively speaking, but a minimum of smoke. Not only is it of naturally high grade, but the care exercised in its mining cleans it of a lot of worthless rubbish that is used for coal in London. Hence, no time is more opportune than the present to place the American product prominently before the British public, for that a wide and lucrative traffic can easily be built up, will hardly be questioned. Where difficulty will be experienced will be inadequate facilities for the transportation of the home commodity. Grain freight practically now controls the tonnage, but it is possible that a fleet of merchant ships may be obtained for the special purpose of coal transportation. A demand usually creates a supply, and a demand for American coal is already commencing to grow. Foreign steamship lines have discovered its virtues as an agent for the generation of steam, and many of the great ocean liners are now making their fastest trips with force derived from fires banked with the native article. The same virtues that have won for it a position on the transatlantic steamers will win for it a position in the manufactories, the rolling mills and the furnaces of Europe.—*The Black Diamond.*



TWENTY-FOUR-INCH SHAPER.

Machine Shop Milling Practice—VIII.

BY HORACE L. ARNOLD.

HORACE L. ARNOLD, ESQ :

Dear Sir:—In the last paragraph in your article in the AMERICAN MACHINIST of February 22d, you refer to the necessity of having the "rack and pinion wear uniformly." If you will again refer to my article, you will see that I was particular to state that the worm gear shaft was to have "free end play," which you will see entirely obviates the necessity of accurate work, and that the two pinions are compelled to offer equal resistance to the bed, regardless of wear or workmanship.

This you will see is, to this extent, an improvement on Mr. Gifford's plan, that the only room for spring is the top ends of the two posts of the machine and the mandrel, whereas his plan only stiffens the main post; whatever spring may be in the bed and tail stock post will count to the detriment of the cutter.

It seems to me that in the machine, as shown in Fig. 35, the weight is wrong side to. In the way shown it has to resist the cut, put the other way it would simply help the cut to take up slack. If a machine is designed so as to use *short* mandrels it is about as good as using *large* ones.

Very truly,
JOHN E. SWEET.

MR. HORACE L. ARNOLD:

Dear Sir:—Your letter received. I have no copy of my letter, and if you include it in your article, please cut it down to the shortest possible dimensions to express the idea, but why not give the ideas in your own language, saying I direct your attention to the omission, or something of that sort? My name gets in the AMERICAN MACHINIST so often that I am ashamed of it.

Very truly,
JOHN E. SWEET.

At the outset of these papers it seemed that any expression of personal opinion, or any criticism of examples given, would be likely to lead to indecisive discussions instead of a close and carefully detailed record of actual work, which alone it was the intention to give; but the practice is so varied, and the whole art is in such a transition, that the mere grouping of seemingly contradictory conditions and effects gives the appearance of critical comment. It has also seemed needful to notice current suggestions (which are certainly *not* "practice") if these papers were to be what was intended, a full and comprehensive survey of the art of milling metals up to the present time; for the suggestions of to day are quite likely to be the practice of to-morrow.

It has been the intention also to make these notices of suggestion as brief as possible, and undoubtedly the scant consideration given to the milling-machine table drive, designed by Professor Sweet and illustrated in the AMERICAN MACHINIST of December 21, 1893, failed entirely to do justice to this pioneer attempt to secure an absolutely uniform advancing effect on the entire surface of the table, so that whatever the location of the line of work resistance may happen to be in reference to the mid line of the work table, the line of driving effect will coincide with the line of work resistance, the whole device being in this particular an equivalent to the "evener" or "double tree" by which each one of a pair of horses is caused to exert the same drawing force on the vehicle to which they are harnessed. The general form of the milling-machine table support is that of the "Grant" double-head milling machine, and affords an excellent support at a considerable fitting cost. The idea of the *spiral* racks on each edge of the table, driven by spiral pinions long enough to cover the table adjustment, the angle of the spiral to have a holding-down effect on the table, is new, without doubt, and for some cuts would be entirely sufficient, while for other cuts it would be found insufficient to keep the table on the ways; since the table is over driven (by a middle vertical rack and pinion) by a separate device, and the

"evener" drive edge located spiral racks and pinions act merely as escapements, the table is, so far, better confined and driven so far as end impulse is concerned, than by any previously proposed device, and in these particulars would seem to fully meet the requirements of the problem.

I do not understand why the spiral pinions are specified by Professor Sweet as "nearly" vertical shafts, as I can see nothing in the conditions of the proposed arrangement to prevent the axis of these pinions being at 90 degrees to the line of table travel, which is supposed to be horizontal.

Nor do I understand why the bearing of these pinions being greater diameter than their pitch circle should cause "great friction." In general terms, the work remaining constant the friction is constant regardless of journal diameter, except as increased journal diameter gives increased lubricant film area, and hence is conducive to easy running and durability. If Professor Sweet intended to say "great *resistance*" instead of "great *friction*," as he did say, the statement is, of course, undeniable.

The proposition to *over* drive by means of a friction-driven element, is old, and has been the subject of at least one careful experiment in good hands; and, though one single experiment can never be held as decisive, the results shown in this case were not encouraging to further use. This experiment was not, however, in the precise line of Professor Sweet's proposed drive; the table had a vertical rack on each edge, and was driven by two equal vertical pinions, one on each side; these pinions were worm-driven at different speeds, one of them being friction connected to its driver and *over* driven. This drive required a surprisingly large power, and its great loss of effect was *supposed* to be due to a large side friction on the table guides. Probably some of the readers of this paper can give more information in regard to this device, as it was patented and had strong advocates.

The inventor was Mr. A. T. Gifford, and the U. S. patent is dated November 17, 1885. It must be distinctly understood that only *one* experiment with this device has come to my notice, and that in a place where the invention was not likely to be received with undeserved favor, and it may have been used or may now be in use with satisfaction elsewhere.

Undoubtedly, as Professor Sweet says, the cutter arbors should be as short as possible, and facility of cutter spindle endwise adjustment is of the utmost importance in milling machines, and should be so accomplished that wherever the mill stands it should always be the same distance from a rigid support.

And, undoubtedly, a main mill spindle bearing 6 inches diameter and 4 inches long is very much better than one 4 inches diameter and 6 inches long; probably the 6 inch diameter gives at least three times the support given by a 4 inch diameter, because of the greatly increased lubricant film surface, and *also* because of the great increase of lubricant film resistance to displacement due to this increased surface, which forces a longer travel of the lubricant before displacement can become detrimental. This subject will have extended notice hereafter, because in all machine tools the journals are too long in proportion to their diameter, and are also incorrect in outline, while in one very important steam-engine detail the journals are invariably made in the correct shape, for the simple reason that practice has shown them unreliable if made in the machine tool-spindle main-bearing form.

In Fig. 35, February 22d, the arrow indicating direction of machine table feed points in the wrong direction. This is an error of my own, and I thank Professor Sweet for calling my attention to it. I visited these machines shown in Fig. 35, and found I had made a blunder. The feed is *against* the mill revolution and the weight works with the feed, as Professor Sweet suggests that it *should*, but "should" is not the correct word for the case, as a smaller weight would be equally effective where the table feed is against the mill cut,

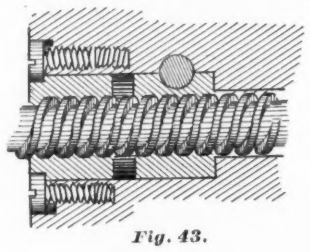


Fig. 43.

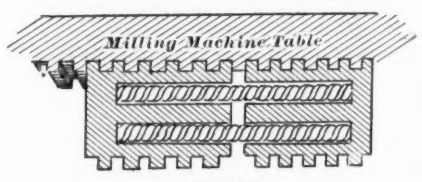


Fig. 44.

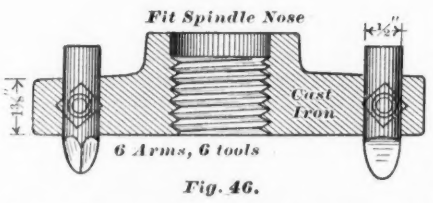


Fig. 46.

if the effect of the weight opposed the direction of the positive feed. The real case is as follows: Where the mill cut is extremely light a uniform table feed can only be had by a table drive absolutely without lost motion; that is to say, the fitting must be so good both ways as to leave room for oil only. This perfection in the feed has not yet been maintained in any case I know of. The watch pinion cutters *do* maintain perfection with a double rack and single-pinion feed, one rack having a fine end movement adjustment; but this feed cannot be said to be maintained by the action of the parts themselves. It is secured by a hand adjustment, and is in continual process of loss by use, and is renewed when its absence becomes noticeable. Of precisely the same class is the double nut, introduced by Colonel Woodruff on the Pratt & Whitney die sinker, 20 years ago, and recently noticed in these columns as a recent origination by some one else. It is undoubtedly very old. In Colonel Woodruff's die-sinker application the single nut was 1¼ inches long; the nut seat was made long enough to take *two* nuts, each 1¼ inches long, with a short space between them, and one was secured in a fixed position, the other in an adjustable endwise manner, so that when the feed became slack, the screw could be put in the lathe, and the threads reduced in thickness to uniformity, and then be replaced and have the slack of the feed taken up by adjusting the endwise movable nut, thus securing at any time a full length, 1¼ inches bearing on each side of the screw threads, all as shown in Fig. 43.

I have also seen drawings of the "Root" drive, with a 7-inch or 8-inch diameter screw in two parts, forced asunder by heavy, coiled springs, as shown in Fig. 44, but was informed it had never been built. I do not see why so manifestly bad an arrangement should ever have been even drawn. It is a device of the same class as the over-driven friction connected and solid connected double rack and pinion drive, and has the same defect of requiring great power.

Where a positive drive, screw or rack and pinion, is aided or resisted by a weight or spring, the case, referring to Fig. 35, February 22, 1894, American Machinist, is as follows: When the pull of weight is with the positive feed, and the feed is against the mill cut, the positive feed is an escapement, and the actual operative element of the feed is the fall of the weight, and the feed has the same uniformity as that of the following side of the screw threads or rack and pinion teeth, and the weight must be heavy enough to *more* than overcome the work done by the mill + friction of the table and weight-carrying parts.

When the pull of the weight is against the positive feed, the positive feed drive is the table-driving element, and the weight and the work *together* must at all times be *more* than enough to overcome the table friction.

Hence clearly, the same weight is *more* effective when applied to the slide *with* the mill revolution, and against the positive feed, than when working with the positive feed and against the mill cut, and in the later case the advance of the table is regulated by the *following* side of the screw thread or pinion teeth, and in the other case by the *leading* side.

As to Professor Sweet's proposition that a small, short mill arbor is as efficient a factor in the production of accurate milled work as a big, long arbor, my own opinion would favor in *all* cases the use of the largest permissible mill arbor for side mills.

In Waterbury, the old home of the first brass-button makers, I saw two fine milling machines, one by Blake & Johnson and one by the Waterbury Farrel Foundry Company. The Blake & Johnson machine is of the vertical spindle type, first made known to me as the Jorden machine, in the E. W. Bliss shops in Brooklyn, and is shown in Fig. 45.

As will be seen from the engraving this machine has a good base, and the table has a good traverse in two directions, while the vertical spindle has a long overhead adjustment, making the machine available for a large range of small and medium pieces, such as are largely produced by Blake & Johnson, who make great use of it, especially for milling dovetails, mostly 45 degrees angle. At the time I saw the machine it had a 45-degree mill 5 inches diameter with 25 teeth in it, and was running 42 revolutions per minute, giving a surface speed of 54 feet per minute, which is very high for cast-iron. The machine was using the coarsest feed 1¼ inches per minute, giving 840 cuts per inch.

This machine has the large number of 16 changes of speed, from 1¼ inches per minute at 42 revolutions of mill spindle to $\frac{1}{16}$ inch per minute at 42 revolutions of spindle. These feeds are finer than I have before seen, and the finest would give over 5,000 cuts per inch with a 25-tooth cutter making 42 revolutions per minute. To reverse the feed two vertical feed cone belts are used, one open and one crossed, and these belts are changed as required. This practice finds support in some or all of the Brainerd machines, which reverse the feed by changing the belt from cross to open, or from open to cross, and until within a few years the Brown & Sharpe index machine feed was so reversed.

The machine is well fitted and was producing an excellent surface on the work. Dovetailing, as is well known, can be very cheaply produced by the vertical spindle mill, and this Blake & Johnson machine can be used to great advantage where much work of this class is produced. It is also, I hardly need say, perfectly adapted for all ordinary small jobs of surfacing, rebating, slotting, and so on, and with a suitable outfit of cutters or mills, can be kept busy in almost any machine shop to very great advantage.

I may here say that in shops where milling is not an established method of finishing, the best of milling machines are often left to stand idle while work which they could do perfectly is done slowly and ex-

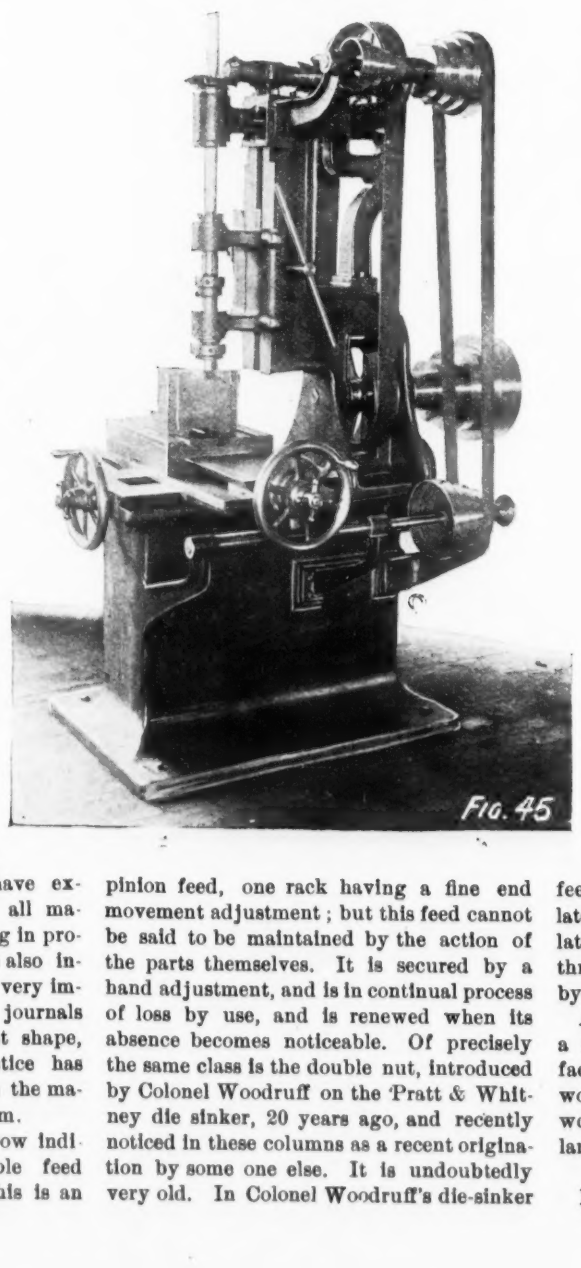


Fig. 45.

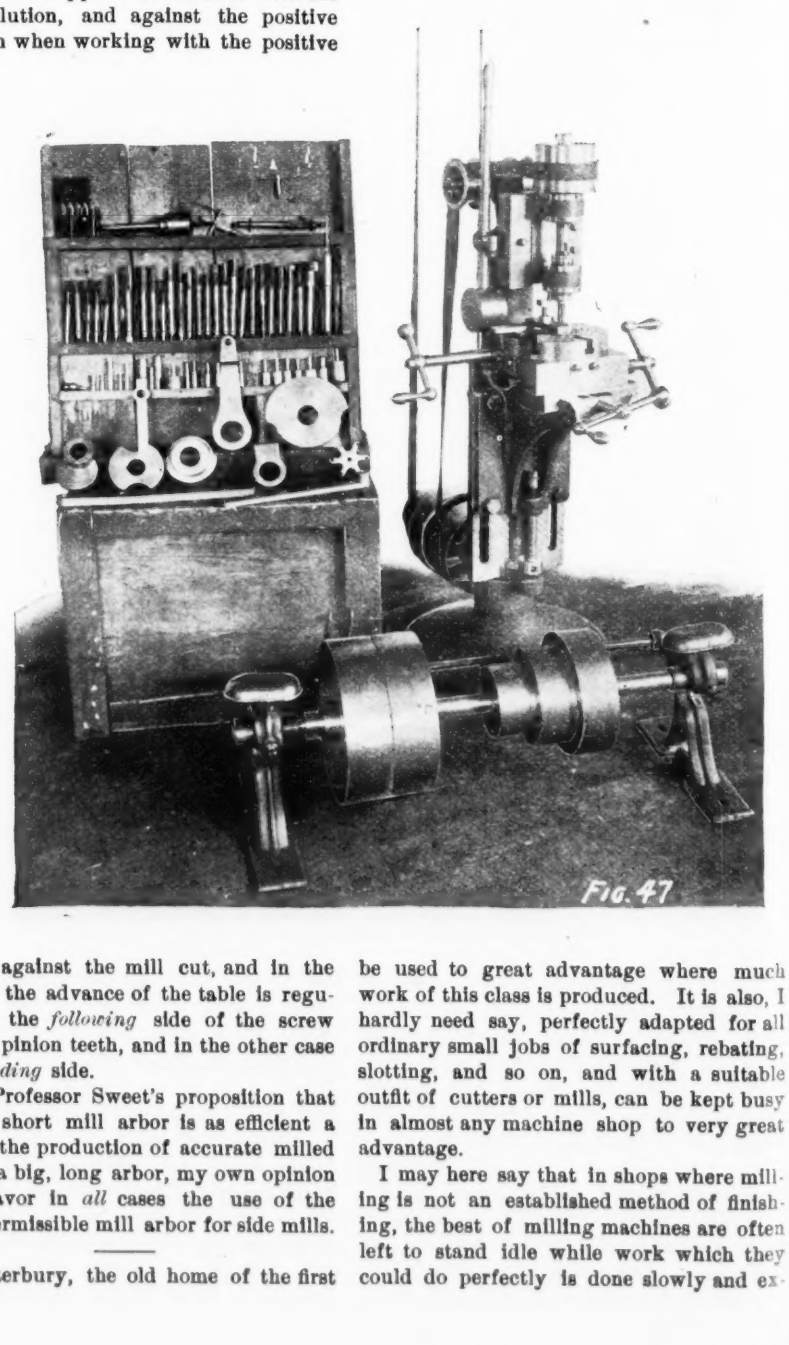


Fig. 47.

pensively, and often imperfectly, by other machines or by hand, simply because the milling machine is not fitted with a suitable range of good mills, or because no hand in the shop understands the care and use of such tools. A friend recently detailed to me an aggravated case of this sort, where a Brown & Sharpe index machine stood idle, covered with dirt, close at hand to a "tool-maker" of foreign extraction who was laboriously chipping and filing the notches in an index dial in the vise. Such a thing would hardly seem possible, but I myself have seen cases almost as bad. Every intending purchaser of milling machines should understand fully that he can expect no satisfactory return from such an investment without providing also a competent hand to run the milling machine, and some efficient means for supplying the machine with suitable cutters, and keeping those cutters sharp and in good order in every way. Good mills can make work cheap and good; bad mills cannot make anything but trouble and expense. These remarks apply to all milling machines as well as to the Blake & Johnson vertical here considered. The actual dimensions of this machine are as follows: Lengthwise travel of table, 19 inches; crosswise travel, 15 inches; vertical movement of spindle, 14 inches; and the spindle and drive are heavy enough to handle a 6-inch end mill efficiently. There is a sliding micrometer on the upright reading to thousandths, so that no other scale is needed for height measurements, and the tool is in every way handy and convenient. Floor space, 69 inches by 45 inches; weight, 3,200 pounds; and the drive is 4-inch belting on 14-inch pulleys.

At Blake & Johnson's I saw the cheapest radial mill so far, shown in Fig. 46. It is a six-arm cross of cast-iron with a hub threaded to fit the spindle nose, and a circle of straight ½-inch diameter holes in the middle of the arm ends; these arm ends are also tapped for $\frac{9}{16}$-inch set-screws, and the teeth are simply short, round pieces of ½ inch tool steel flattened on the side, slipped into the holes and fastened with the set-screws. I should say $5 would cover the shop cost of a 6-inch mill of this style, and it was doing about as fast and good work as any end mill I have seen. The same tool is also shown in the engraving of the Waterbury Farrel Foundry die sinker, Fig. 47.

This is a small tool of low cost, and most surprising efficiency, for which I was at a loss to account at first; part of the ability of this machine to remove metal is undoubtedly due to its small size which makes it sensitive, so that the action of the machine conveyed to the operator by the exclusively hand-feeds enables him to force the cutter to its highest possible efficiency, so that the element of hand skill is a direct factor in the machine action; part is also due to the *light* drive, which is kept just below the mill tooth breaking point of efficiency, so that the hand has no fear of breakage, but by far the most important point is undoubtedly the manner of boxing the spindle, which, although very well known in Waterbury, and also at the Winchester Arms Company's shops, was entirely new to me, and which is, I believe, better than anything else of the class.

Mr. Lamb, superintendent of the Waterbury Farrel Foundry—(as is well known there is also an Ansonia Farrel Foundry, the two concerns, which are both large and eminent, having no connection with each other) very kindly arranged shelves of tools and samples of work produced with this machine, so that all could be photographed together as shown in Fig. 47.

Owing to unexpected thoughtfulness on the part of some one the countershaft is given a prominence in the engraving which neither Mr. Lamb nor myself intended, but the assortment of tools shown is an instructive display, quite in line with foregoing remarks as to what is needed to make milling machines useful.

As will be seen from Fig. 47 this small Farrel Foundry die sinker has a balanced vertical spindle action, a revolving work table on double crossways mounted on a vertically adjustable knee, and all of the feeds and adjustments are exclusively hand operated. The knee elevating screw has a capstan head, and is, therefore, not so quickly operated as if hand-crank driven; but in the Farrel Foundry line of work put on this machine, of which two are kept in constant use, this knee adjustment is seldom changed, the 2 inches or 2½ inches of vertical spindle adjustment being sufficient to cover their ordinary range. For general use the crank drive on the knee adjustment might prove valuable. The samples of work shown in front of the tool shelves are only a small part of the shapes the machine can produce, and the surface is extremely good, even when large cuts are taken. Mr. Lamb said that the introduction of this machine had spoiled his blacksmiths, and illustrated his remark by some bored forgings for rod ends, where the eyes were all the way from ⅛ inch to ⅜ inch out of round, explaining that

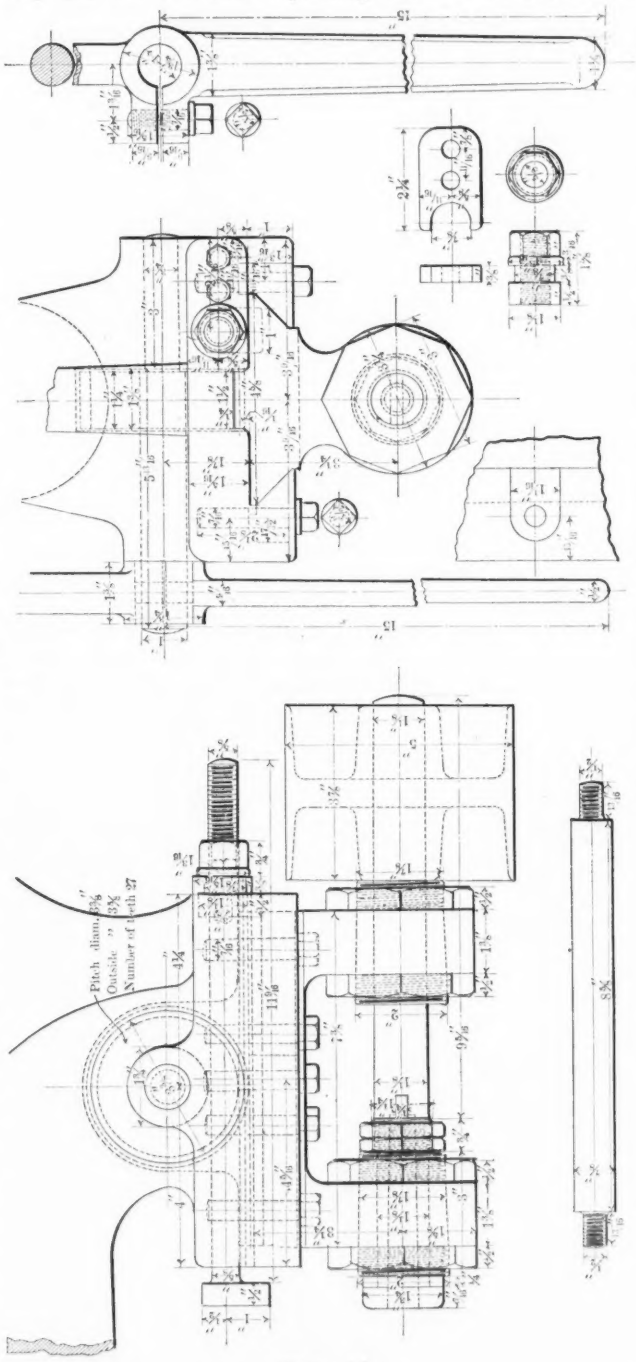


Fig. 48.

these little machines could remove stock so fast that it was cheaper *not* to make close forging on surfaces to be finished by their use. I had long before observed that while large milling machines seem to take cuts out of all proportion small for the bigness of the tool, small milling machines take cuts out of all proportion large for the size of machine, and this die sinker can easily and rapidly remove a thickness of metal equal to one third of its mill-spindle diameter, and leave a smooth surface. The engraving shows the machine so clearly, and the whole is so simple that no description is needed. The diameter of the circular work table is about 12 inches I think, and the whole machine is so small that as shown it is the right height for a man sitting on an ordinary low stool to handle.

The remarkable efficiency of this machine led me to request blue prints of the spindle mounting, which are given in Fig. 48. At the time I saw these machines Mr. Lamb called my attention to the entire absence of lost motion or side shake in the spindles, and said their large cut and smooth surface work was due to this close fit. I tried moving a spindle by hand, and found that it took a hard twist on the 5-inch spindle pulley with both hands to start the spindle, but that once started the revolution was quite easy, though still extremely close in feel to the hand, entirely unlike anything I had ever seen.

As the blue prints when received showed nothing beyond a spindle with straight journals mounted in outside tapered boxes adjustable endwise, impossibly, in tapered spindle head seats in the cast-iron spindle head, I wrote Mr. Lamb for further information, and had the following reply:

Horace L. Arnold:

Dear Sir: In reply to yours of the 20th, in reference to small milling machine, I would say that the spindle runs in babbitt boxes. These boxes are cast, bored and turned true and exact as if made of steel. They are split on one side only and about $\frac{9}{16}$" wide; the slot is fitted with maple wood nicely fitted in. The wood offers enough resistance to the closing of the box, and at the same time will compress sufficiently for any necessary adjustment for a long time, and can, of course, be filed down if necessary. We have run these boxes for several years and I do not know of the wood being reduced. The spindle bearings should be made with as much care as if intended to run in hardened boxes. We bore the conical holes in the sliding head in line by using a good stiff boring bar with shell reamers—the reamers should be ground inside and out with sharp cutting edges, and by care a very true hole can be obtained. The nuts on each end of the babbitt box to be correct should be square threaded and rather fine pitch. Only the best babbitt should be used. We have never provided means of keeping the box from turning in its seat, and if wood filling is placed in line upon, say, the right-hand side of machine, I hardly think it will change position by any movement of the nuts that will ever be required. I have not attempted to word these answers for your purpose, but only to give you our ideas which you will, of course, fix up in proper shape.

Yours truly,

Geo. B. Lamb.

The particular babbitt used for these boxes is "Hoyt's copper hardened." Mr. Lamb also recommends tin 100, copper 10, antimony 10, as suitable for the place.

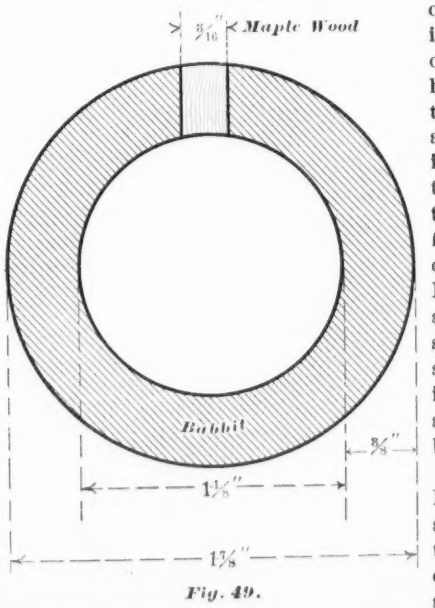


Fig. 49.

The, to me, entirely novel element of the compressible wood strip in this spindle box led me to seek further information from Mr. Lamb, who said the box originally came out of the clock shops, being employed for the spindles of the wheel cutting engines, the box being a straight hole outside taper of cast iron, with nuts on both ends and a strip of wood filling as described. These wheel engine spindles were about 1 inch or 1⅛ inches diameter, carried a tooth-cutting mill, about like a Brown & Sharpe gear tooth cutter, running about 3,000 turns per minute; the machine had a rack and pinion hand feed, and a hand index, and the operator cut a string of clock wheels on an arbor with his left hand on the index, and his right hand on the rack pinion crank, the pinion being so large that only a partial revolution of the crank was needed to cover the length of cut, which was made as rapidly as the hand could move, a string of wheels being toothed in an incredibly short space of time, as the three thousand turns of the mill gave a fine per tooth feed at any possible rate of hand actuated feed. Mr. Lamb said he had made these wheel-engine spindles, and did not think any other spindle box could stand up to the work. The wood filling of the compression cut undoubtedly fills three distinct offices in these boxes: first, it is a compression element, and, second, it has nearly the same resistance to wear as babbitt, so that the spindle box resists wear at the compression cut about the same as if the cut were absent and the box solid, and, third, it is an efficient oil reservoir and lubricator. Mr. Lamb also informed me that it is the intention at the Winchester Armory to make no file cuts, and hence the use there of a vast number of small special milling machines for making never changed cuts very rapidly, all of which are fitted with this particular split and wood filled spindle box, giving results which are believed to be obtainable by no other means. Certainly a spindle mounted in these split and wood filled boxes feels entirely different to the hand from any differently mounted spindle I ever saw, and can endure a closeness of fit which would lead to instant heating with any other construction; perhaps it may be assumed that the wood filling has a fourth use, in compressing as the box heats, so as to allow the babbitt box to expand in its closely-fitting cast iron seat without pinching the spindle. If this is, as it seems to be, absolutely the best tool spindle box, the extended space I have given to it is well deserved. A full-size mid section of this box is shown in Fig. 49.

As for the Farrel Foundry die sinker, with a good hand and good tools, it will save its cost every six months in any shop where there is work for it, and which uses lathes and planers or shapers only. It can produce a general line of small face-plate lathe work very economically, and can do all kinds of small planer and shaper work about five times as fast as planers or shapers can do it, and leave a better surface. No more generally useful tool can be placed in any machine shop, large or small, and for steam engine work it is particularly useful for gibs and keys, straps, boxes and all detail work. The revolving table takes quite a large vise, and large nuts can be rapidly finished on the bare table, which may be graduated on the edge. In fact, simple as this tool is, in good hands it has a surprising range and efficiency.

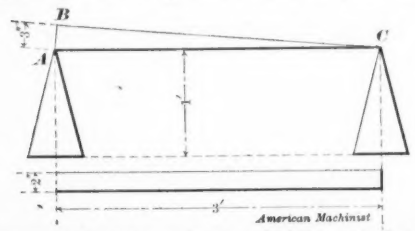
Ambrose Webster, of Waltham, Mass., and James E. Greensmith, manager of the Portland Works, Portland, Maine, are among the well-known mechanics who are abroad.

LETTERS FROM PRACTICAL MEN.

A Problem in Physics.

Editor American Machinist:

I herewith propose a problem in physics to the readers of the American Machinist, a problem which I have never seen in any treatise in physics, but one which may have a practical application in mechanics, as I have recently found it necessary to consider it in connection with the construction of a machine. In the figure let *A B C* represent a triangular piece of metal, homogeneous and of equal thickness in plan and



supported at the ends at a height of 1 foot from the face of the supports. Let the dimensions be as indicated, and the specific gravity be that of cast-iron gun metal, or, as Haswell gives it, 7.308, the weight of water at maximum density. On this assumption, a cubic inch of the metal weighs 0.264 of a pound. It is required to determine whether, were either of the supports removed, the free end of the supported piece would fall through the distance of 1 foot quicker or slower than the center of gravity would fall through the same distance were both supports removed so that the entire mass could fall freely; and, if either quicker or slower, it is also required to ascertain in what time either end would fall through a distance of 1 foot were the support at that end suddenly removed without disturbing the other. The fall is to be estimated in vertical distance, and not measured on the arc which the free end would describe around the apex of the other support as a center. I have preferred to give this particular problem rather than to generalize it; but a general formula will be easily deduced from the solution of this particular case.

Leicester Allen.

Chilled Crusher Rolls.

Editor American Machinist:

In reply to Mr. Ramp's inquiry as to cause of marks on chilled crusher rolls, I would say that I have made a great many of them in the following manner: The chill was of the ordinary kind with a green sand core, having a vertical runner in center of same 2½ inches square, and two others leading from it. These are set flush with the bottom of the mold, and somewhat curved. After the pattern is drawn the chill is heated, sand-papered and blacked with plumbago and oil which is rubbed smooth. If the chill has not been used recently, the first one or two might show the marks, but after that there should be no trouble.

E. J. Condon.

Making Drawings for Machinists' Use—Accurate Work.

Editor American Machinist:

In your issue of February 22d Mr. Lawrence gives some advice about dimensions on drawings that is to the point in many cases, but in some and in the particular cases cited I shall have to differ from him.

I cannot think of a place where it is not advisable to give the lengths of the arms of levers between centers.

Fig. 1 is what Mr. Lawrence considers a bad way to give dimensions, and Fig. 2 a better way. Now, of course, which way is best will depend upon how the machinist would go about to lay out such a piece of work. If he should attempt to do it by the way hinted at by Mr. Lawrence, that is, by the use of surface plate, surface gauge, square and such tools, then, of course, Fig. 2 would be best, but would not this be an awkward way to go about it?

The most practical way I know of to finish such a lever to dimensions would be this: First bore the hole in long hub by holding it in a good lathe chuck and truing it by the hub, also by the arms as far as they require, and square the front end of hub in the position it is bored in, then square the other end on an arbor. Now clamp a faced end of hub on a planer platen with bolt through the bored hole, and after properly supporting the outer hubs, plane them off. Now set a pointed tool in the lathe tool-post and locate it just 10⅛ inches off center, then place the work on the arbor again in the lathe and scratch the radius (10⅛) on the face of hub on long lever. Now locate the front of tool 4⅛ inches off center and scratch radius of short lever as before.

Now inspect the casting roughly to see if it is in the shape intended, for if not so, the holes may be located in the hubs so as to divide the error.

If the casting is in good shape one hole may be drilled and reamed at the radius marked and in the center of hub. After finishing this hole it is an easy matter to place an arbor in it so as to project far enough to measure from the diagonal distance 10¼ inches, which would intersect the radius line already drawn, so by this way Fig. 1 would be just right.

This would be for an ordinary job, but where accuracy is required it would be a longer job and, of course, more expensive.

In Mr. Lawrence's improvement (Fig. 2) he has given a dimension of 4.334 inches. Now, the machinist would not know the reason for this, that is, how it was got, so he would think that 4.333 or 4.335 would not answer, and in case there was no way at hand to know more about it than the drawing showed, I think there would be a great waste of time, that is, considering that it could be done well enough by the way Mr. Lawrence mentions, for this would be equal to saying that within $\frac{1}{64}$ inch would be near enough.

I have known a great many men who had no originality at all, and who claimed there was no need of any in a machine shop. Everything was done by rule wherever the rule would possibly fit, and where their rule would not fit they were stuck.

Here are some samples of these rules: Turning must be done on a lathe; milling must be done on a milling machine; boring must be done on a boring machine, and all work to be laid out with lines must be done on a surface plate with surface gauge, square, and such things. I have always contended that such rules were better for horses than men. They should have no place in a machine shop.

If you have a job of turning that can be done cheaper and better on a milling machine than on a lathe, I do not know of any law to prevent using the milling machine for the purpose. If you can do that particular job of milling on the lathe better than on the milling machine, why not do it that way?

Just let me review a way of laying out such a lever on a surface plate, somewhere used, and then say if there are not many reasons why such a piece of work can be laid out better in the lathe.

I would first bore the central hole and square the hubs as before. I find a nice true surface plate. Perhaps the owner would object to having me draw a lot of lines upon it if he knew, but as he does not then he need not be bothered.

Fig. 3 will represent the surface plate. I draw the lines *A B C* parallel and the correct distance apart as near as I can.

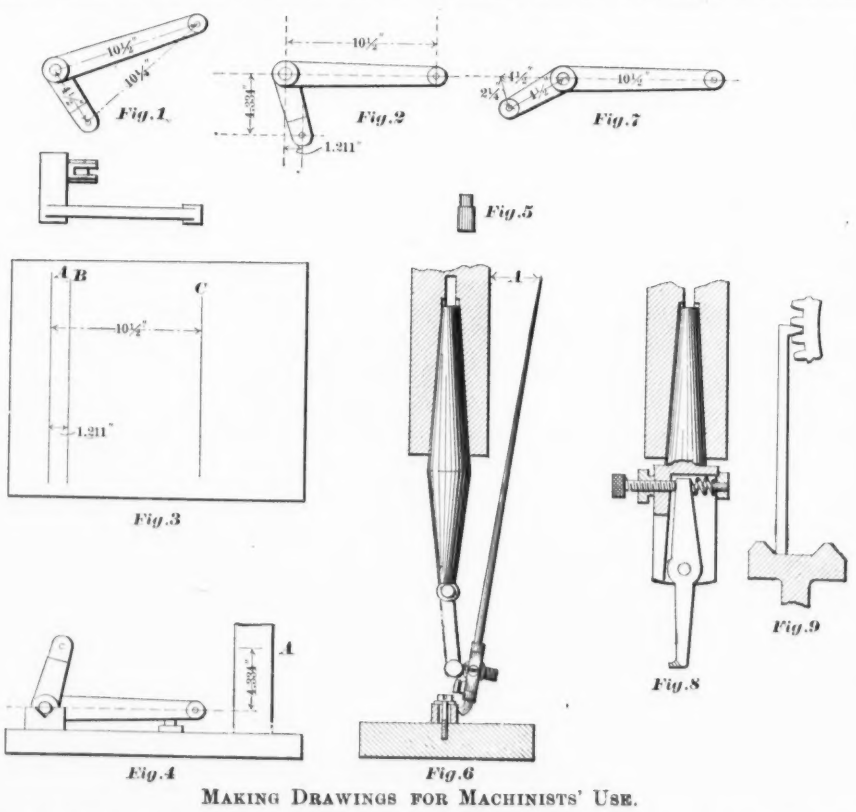
Perhaps I have not got thousandths on my scale, but John Jones has one of D., B. & S. make, with a number of little dots on one end that has bothered John greatly to understand the reason for, but I happen to know about that, so manage to transfer this 4 334 to the work as close as $\frac{1}{64}$ inch. This is accurate work on the principle I once heard a workman suggest, "Lay the work out wrong so you can do it wrong, and then have it come right."

I next place a straight arbor in the bored hole and mount the work on V blocks, as in Fig. 4.

I set the surface gauge to the height of center of arbor then transfer this height to the block *A*.

I then lay out on the block *A* the distance 4.334. By the use of a good square and scale I make the center line of arbor stand directly over the line *A* (Fig. 3) and parallel to it. I can then scratch the line on short arm to correspond with top line of block *A*, also scratch line on long arm to correspond with low line on height block. I can also project the lines from plate with the square; but what about the next fellow who wants to use that surface plate for a similar job? Can he tell his lines from mine?

Mr. McGregor, in your issue of February 22d, tells of using a little button and an indicator for closely locating holes. This plan can be used for locating holes in such a lever where great accuracy is required. Place a small plug in the central hole with the outer end made to some easy size, as in Fig. 5, then buttons of sufficient length can be used which can be located from the central hole by the use of accurate end measures.



Making Drawings for Machinists' Use.

These buttons must be trued in the lathe and the holes bored without reaming. Sometimes a lathe large enough for the work would be hard to find; in that case a good drill press will do first rate.

With an indicator, as in Fig. 6, a button can be trued as well as in the lathe by simply measuring the distance *A* with a scale on four sides.

There is a tool something like Fig. 8 that has yet to introduce itself in many shops.

This tool will permit boring in a drill press about as good as in the lathe.

It is of value sometimes in starting holes where the casting is not sound.

Fig. 7 shows another form of lever and dimensions as I would prefer them for laying out accurately in the lathe.

Fig. 9 represents a bent piece of iron for indexing from the large gear on lathe spindle. This comes in very handy sometimes to a man who uses his brain in preference to somebody's rule.

Making drawings does not differ much in some respects from writing letters. If we have reason to believe the person we write to is familiar with the subject we need not be near so particular as when we know we must throw light on a subject the person knows nothing of.

We see some draftsmen who are young and green enough to think they know it all. They try to show every little point on their drawings, and because they happen to know more of the little points than the larger ones, they are liable to overlook the larger ones altogether.

"There are tricks in all trades." This is just as true to-day as it ever was, and the machinist's trade is no exception. The draftsman is entitled to his share of the credit in the construction of a machine, but not *all* the credit. The designer may want a little, and even the poor machinist thinks he can, and does do a little more than furnish the hands. The best managed machine shops are where the greatest wisdom is used to draw the line as to how far each shall go with his work.

The draftsman who undertakes to write or draw to machinists on subjects the machinist knows all about is wasting time.

The draftsman who was so very particular to make his drawing tell about drilling a hole in a piece of steel before hardening, was sticking his nose in some other fellow's business, and could have used his time to better advantage in his own line.

The machinist who would need to be told such a thing would need a remarkable drawing to make the business plain to him.

A Mechanic.

The Planimeter.

Editor American Machinist:

Does it not seem to be rather late in the day to be suggesting doubts as to the reliability of the planimeter as "Quirk" is doing? Before the planimeter was adopted its accuracy was demonstrated, and its extensive use since has only confirmed the verdict. It has, however, often occurred to me that whoever makes use of the planimeter should take pains to establish his confidence in it and at the same time ascertain his "personal equation" in relation to it by tracing a sufficient number of figures of known or computable area. I confess that I do not like the method suggested by Mr. Barnes, in the American Machinist, April 12th, of tracing irregular figures upon drawing paper and then cutting them out and weighing them. I would have as little confidence in results so obtained as "Quirk" seems to have in the planimeter. The method is "unmechanical," and it is unmechanical simply because it is not the best or most accurate way. Either a series of regular figures of easily computable areas may be traced, or, what is better, several irregular figures with all the crooks and turns that occur in practical indicator diagrams may be traced within some regular figure, occupying the whole of it, and then the sum of these inclosed areas being known, and compared with the sum of the planimeter readings, the comparison will tell the story. By some such method the planimeter should be vindicated. Will not some enterprising reader of the American Machinist favor us with a little report of such an investigation? The old method of measuring the indicator card by taking the mean of a series of ordinates might be at the same time compared with the planimeter work.

Frank Richards.

Long vs. Short Connections to Indicators—Counterbalancing Engines.

Editor American Machinist:

I have followed with interest the discussion of the question, whether or not it is

worth while to pay any attention to the length and directness of indicator connections, which has appeared in your columns. The case seems to me to be well summed up by Mr. Wakeman in the last sentence of his letter in your last issue, as follows: "While long connections sometimes give correct results, short ones always do."

For my own practice, I settled this question experimentally long ago. In the year 1862 I took the second Porter-Allen engine, and the second Richards' indicator ever made to the London Exhibition. The engine was a little one, of old-fashioned proportions, 8 inches diameter of cylinder by 24 inches stroke, and ran at the then unheard-of speed of 150 revolutions per minute. The indicator connections were of the orthodox style. A three-way cock was set on the lagging at the middle of the cylinder, and connections were made from it to the little steam chimneys provided on top of the cylinder over each clearance space, which last feature I have always retained. These connections were short and ample, and involved only two deflections of the current of steam. The lead was given to the valves which the indicator showed to be required. After a week or two, something, I forget what, raised the question in my mind whether the lead was really what the indicator said it was. I took off this rigging, which was so convenient, avoiding all occasion for moving the hot indicator, and enabling the diagrams from the opposite sides of the piston to be drawn on one card, and set the indicator on straight-way cocks at the ends of the cylinder. A marked change appeared in the lead line. The valves had been given a good deal too much lead. I have never used a long connection since. I never cared to discuss the matter. The diagram taken with a long connection may be correct; with a short one, so far as it is affected by the connection, I *know* it is.

In any investigation it should certainly be a prime object to avoid all chance of error. There remain chances enough to be avoided, why add to them? The lead line is one which it is especially important to know represents the fact correctly. Can any one employing a long connection say that he *knows* the representation of the admission of the steam given by his indicator to be correct? Not unless he has used a close connection to prove it.

My attention is attracted by another subject, which is referred to in the same issue of your journal, namely, that of balancing an engine. This is a subject on which I carried on, a number of years ago, a series of exhaustive experiments, the results of which were as follows: First, the counterweight must be set exactly opposite the crank. Second, balancing must be in the horizontal direction only.

From the latter, it follows that in a vertical engine the only part additional to the crank itself that requires to be balanced is the crank end of the connecting rod. This is on account of its horizontal vibration. Third, for perfect balancing in a horizontal engine the counterweight should equal, at a distance from the center equal to the length of the crank, the entire weight of the reciprocating parts. Less than this will, however, generally, answer, the unbalanced portion of these parts not exerting force enough, by its inertia, to disturb the engine at the speed employed. If perfectly balanced, an engine may be run at any speed whatever, and will remain entirely still. The most interesting experiment I think I ever tried was in the works of Sir Joseph Whitworth, in Manchester, with a small engine, exactly balanced, and set so as to be free to move, the bottom of the bed being planed and lying on a planed surface. When running at full speed, the engine had a steady motion backward. I soon detected the cause of this in the angular vibration of the connecting rod. The centrifugal stress of the counterweight was, of course, the same on each dead center. The acceleration of the reciprocating parts of the engine was *not* the same on the opposite centers, but was 40 per cent. greater on the back center than on the forward one. The stress of the reciprocating parts was, therefore, alternately, greater and less than that of the counterweight by 20 per cent., and the excess, alternately that of the reciprocating parts and of the counterweight, was always exerted in the backward direction. The problem of balancing locomotives is complicated by the vertical action of the counterweight, which at high velocities pounds the rails severely, but in the case of stationary engines no real difficulties are presented.

Charles T. Porter.

Traction Engines.

Editor American Machinist:

The traction has been called the brother of the locomotive, and their close relationship will probably serve as an excuse for those traction builders who try to imitate the locomotive in some of its mechanical details. Numerous attempts have been made to do away with the link in locomotive practice, but the link with all its faults is still controlling the steam of more locomotives than all other forms of valve gear combined, and because it has held its own on locomotives some traction builders say there is nothing as good as it for their use.

A locomotive is a locomotive all the time, while a traction is used as a stationary probably 10 hours and then used a short time as a traction for moving itself and machinery it has been driving. Now, if stationary engines of small horse-power are made with automatic cut-off and work economically under varying loads, why is it that an automatic cut-off cannot be made which will give equally as good results, since the machine is more of a stationary than a traction?

I think that if properly designed it would give greater power, with less weight, than could be expected from compounding.

One disadvantage would be that it would have to be detached while being used as a traction unless some radically different form of governor was used than is used now. This, I think, has been one of the chief reasons why an automatic valve gear has not been applied to tractions. The link has been a favorite because it made a good combination for variable cut-off and reverse. Some builders have finally come to the conclusion that locomotives have slightly different duties to perform, are operated by a different class of help, and are run into or near a machine shop every few days. Not so with the traction, it is generally operated by that class of help that makes a coroner's jury a necessity, if we may judge of the reports of boiler explosions, and to suit these conditions some manufacturers are discarding the link and are adopting simpler methods, and in one or two instances a better steam distribution is obtained.

The indicator has been such an important factor in developing the automatic cut-off to its present state of perfection that I cannot understand why its use is not more general among traction-engine builders. I am afraid if it was there would be considerable re designing of engines and boilers.

Some time ago I took a diagram from a 7x10, and found more back pressure than should have been, and on investigating found the exhaust pipe reduced to ⅝ inch in order to get sufficient draught.

The engine considered by itself gave a very fair card for an ordinary slide valve. When you apply an indicator to a traction engine you run up against engine and boiler design combined.

Inventors have confined their efforts more to traction appliances than to making and using steam economically.

E. Williams.

Cleveland, Ohio.

Power Required to Drive Machine Tools.

Editor American Machinist:

The article in the April 12th issue of the American Machinist, by Prof. J. J. Flather, on "Power Required to Drive Machine Tools," is one of the very best articles we have ever seen—it is timely and fills a long-felt want. Kindly send us half-dozen copies of this issue, together with bill for same.

This is very valuable information to electrical fraternities generally; it has been demonstrated by actual test that from 60 to 68 per cent. of the power used in machine shops and other places is absorbed by the friction of the line and countershafting, and there is a strong tendency now to have an independent motor for each tool. The data contained in the article will enable us to get directly, without experimenting, at the power required to drive each tool.

Fisher Electrical Mfg. Co.,
Frank E. Fisher, Treasurer.

Manganese Steel for Safes.

Editor American Machinist:

Mr. Kent's letter, in your issue of March 8th, puts me in mind to say that the safe maker can with certainty guard against some, at least, of the burglar's modes of attack, by making his safe of manganese steel. The burglar can draw the temper of any common steel plate, or of any composite plate, by simply applying a blow pipe, such as he can buy at any hardware shop. The temper drawn he can drill it through as if it were so much soft iron. But he cannot draw the temper of manganese steel in any way, for neither heat nor any other known thing will soften it. Let him heat it with his blow pipe, and as soon as it is cool enough not to draw the temper of his drill, it will be as hard as ever. I happen to know that some of our most intelligent safe makers are now experimenting with this material for this very reason.

It is not only so hard that it cannot be drilled, but also so tough and ductile that it can neither be broken nor cracked by sledging. Moreover, no matter how thick the plates which the safe maker uses, they are uniformly hard clear through, undrillable and unbreakable from one face to the other. A 5-inch plate of five-ply chrome steel can at most have some 3 inches of hard metal. A 5 inch plate of manganese steel has five solid inches of undrillable metal. As it can be cast readily, a safe or a chest can be made in a single piece; and walls absolutely of any thickness you please, a foot or even 2 feet thick, if you want, can be made readily and at moderate cost.

Finally, once your burglar is incarcerated behind bars of manganese steel, you may be sure that he cannot escape through them, for he can neither file nor smash them.

Here, then, the safe maker and jail builder have a new means of meeting the burglar.

Zen Brinus Lyon.

"The Personnel of the Navy."

Editor American Machinist:

I notice in your issue of the 5th inst., an editorial on "The Personnel of the Navy," which, I think, is somewhat unjust to the commanding officer of the "Yorktown." We do not know—and probably the "petty officer" does not know—why the captain exercises this "paternal relation" over his men; but all who know anything about naval affairs do know that if "the boys" should be allowed to attend the Midwinter Fair with $300 in their pockets, the chances are that some of them would not turn up at the end of their two-days' furlough. It is well known that no man is less capable of taking care of his own affairs than the sailor or soldier on leave.

It is *historically* certain that the glorious victories of the American Navy were won by vessels manned by men who were kept under a far sterner and more brutal discipline than that to which the sailors of the "Yorktown" are subjected. What a good, self-respecting citizen must the man have been, who, for every petty offense, was flogged at the mast by the arbitrary order of his captain! Naval victories have been won in the past, as they will be won in the future, by vessels commanded by men who kept their crews under the strictest discipline. What caused the defeat of the "Chesapeake" but the fact that Lawrence had had no time to train and discipline his crew?

The condition of the American seaman will never be improved by permitting him to attend Midwinter Fairs with $300 in his pocket.

Let us hope that the bonds of discipline in the Navy will never be relaxed.

The Army has experienced the most deplorable consequences of such a course.

Bayard Guthrie.

South Bethlehem, Pa.

Ericsson's Success.

Editor American Machinist:

In your number of April 5th I find that "Easy Way" in his talk of "The Fellows Who Make Drawings and How They Make Them," compares the work of Swedes and Norwegians with that of the "brilliantly unsuccessful Ericsson." What I want to know is: In what way did Ericsson prove to be unsuccessful? It seems to me that if every one of the Swedes and Norwegians, and others for that matter, could reach world-wide fame accomplishing as great things as did Ericsson, they would then have good reason to be proud of their career.

Fulton, N. Y. C. M.

Expansion of Cast-iron During Solidification.

Editor American Machinist:

In answer to Question (117) of J. H. T., Chicago, Ill., March 8, 1894, I copy a memorandum concerning an experiment made by myself, 1880, at the Iron Bay Foundry, Marquette, Mich. A bar 1⅛ inches square, 3 feet long, cast in open sand, and measured as soon as the iron was sufficiently set to allow measuring, was found to be ⅛ inch longer than the pattern. It remained the same length for about 10 minutes, appeared to shrink after that time at a uniform rate as it cooled, and measured 3 feet when cold. The length of the pattern was 3 feet by the shrinkage rule. My object at the time of making the experiment was to observe the relative time and uniformity of shrinkage. Being astonished at the outcome I repeated the experiment with precisely the same result. Of course, this will not affect the work of the patternmaker in regard to his rule. But it shows that the actual shrinkage of a casting after solidification may be considerably more than generally supposed, a fact which should be well considered in designing, molding and casting. The result will be different when casting in dry or green sand. A wheel cast in a chill is apt to come out smaller in diameter than a casting of the same pattern made in green sand.

Chicago, Ill. M. Jacker, M. E.

In reply to the communication from Mr. G. W. Bissell, in regard to utilizing the waste heat from gas engines for warming purposes, Schleicher, Schumm & Co. (manufacturers of the Otto gas engine) write us: "The idea has already practically been tested by leading the waste water through radiating apparatus of large surface. There is, however, not very much in it as the heat available is comparatively small."

Mr. Harris Tabor, in his letter published in our issue of April 19th, wrote: "Locomotive cylinders are supplied with very small steam pipes and ports; so small, in fact, they *wire* draw steam to an extent that would not be permitted in stationary or marine service." The "intelligent" but non-technical compositor put will for wire.

The fact that one English firm having voluntarily agreed on an eight hour day with their employes have found it a success does not show, as some assert, that such a regulation should be made universal by law. The one thing it proves is that the relations between these manufacturers and their men are those of trust and confidence. —*The Sun.*

Well, suppose the relations between manufacturers and their men was always one of trust and confidence. Perhaps there is not so very much in the way of this as may be imagined.

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The Caldwell Decision.

One of our railroad contemporaries has, it seems, gone into the business of criticising the decisions of U. S. Courts and does it too in what must be considered a very unjudicial manner, to say the least. By this contemporary (*The Railroad Gazette*) Judge Caldwell is put down as an "extraordinary judge," as making "most undignified remarks," and "the shallowness of his reasoning" is spoken of apparently for no other reason than that he had proven himself able to recognize that the Union Pacific employes had rights under their contract with the officials.

The *Gazette* says with much show of indignation that "the existing wage rates are held [by Judge Caldwell] to be fair and just, because they have been in force a long time—most of them eight years."

The language of the decision, as actually printed elsewhere in our contemporary's columns, will bear no such construction, and would, we think, not be understood in that way except by one utterly blinded by prejudice. All it does say is, in effect, that the terms of the agreement must be observed.

We quote below some of the most striking passages of the decision, and while we think no fair-minded person can take exception to them, it is, of course, easy to see why the decision is so pleasing to the employes:

Two of the ablest managers, S. H. H. Clark and Edward Dickinson, testify that these labor organizations on this system had improved the morals and efficiency of the men, and had rendered valuable aid to the company in perfecting and putting into force the rules and regulations. . . Among the regulations was one to the effect that no change should be made in the rules and regulations, and the rate of wages, without first giving to the labor organizations 30 days' notice, or other reasonable notice.

. . . When a road comes under the management of a court in which the employes are conceded to be experienced and capable, the court will not, upon light and trivial grounds, dispense with their services or reduce their wages. And when the schedule of wages in force at the time the court assumes the management of the road is the result of a mutual agreement between the company and the employes which has been in force for years, the court will presume the schedule is reasonable and just, and any one disputing that presumption will be required to overthrow it by satisfactory proof. This the court contends has not been done by the receivers, although they had all recommended that a cut be made. It is the court's belief that the receivers made the request ignorantly, as only one of them is a practical railroad man, and their opinions upon the wage schedules are confessedly of little value. The court shares in their anxiety to have an economical administration of this trust to the end that those that own the property and have liens upon it may get out of it what is fairly their due. But to accomplish this desirable result the wages of the men must not be reduced below a reasonable and just compensation for their services. They must be paid fair wages, though no dividends are paid on the stock and no interest paid on the bonds.

It is a part of the public history of the country, of which the court will take judicial notice, that for the first $36,000,000 of stock issued this company received less than two cents on the dollar, and the profit of construction represented by outstanding bonds was $43,929,328. There would seem to be no equity in reducing the wages of employes below what is reasonable and just in order to pay dividends on stock and interest on bonds of this character.

To a paper the policy of which is to always assume that railroad officials are right and the other employes wrong in any difference which may arise between them, such language from a United States Judge is, of course, nothing less than high treason, but most other people will, we think, fail to find much in it that is not right and sound.

And while we are about it, we may as well say that the enacting and upholding of laws in this country depends mainly upon just the class of men who do the work on the Union Pacific system, and that it is good policy, saying nothing of equity, to show such men that there is some law on their side, and that when the law plainly is on their side they will get the benefit of it. A thorough conviction of this may save a great deal of trouble for all concerned—even for receivers and editors of high and mighty railroad papers.

Monday Accidents to Workmen.

The *Indépendance Belge*, it seems, published a table giving the indemnity claims of workmen for accidents. It appears from this table that considerably more accidents occur on Mondays than on other days of the week, the nearest approach to Monday's figures being those of Saturday.

The *Indépendance* charges Saturday's excess of accidents to the use of ladders, etc., used in the weekly cleaning up, and from which workmen often fall and injure themselves, while Monday's excess is charged solely to the effects of Sunday's drinking.

We do not, of course, know positively how these things are in Belgium, but if the *Evening Post*, which quotes the figures and accepts the conclusions of the *Indépendance*, knew much about workmen or workshops, it would know that more overhead oiling is done on Monday mornings than on any other, and that new and inexperienced employes start work in far greater numbers on Monday mornings than on any other of the week. While we freely admit that Sunday's drinking unnerves many workmen on Monday morning, as indeed it does many who are not workmen also, the circumstances we have named will be recognized by all who have had much to do with shops and factories as having very much to do with the matter as well.

Armor-plate Frauds.

Some weeks ago, it will be remembered, we called attention to some queer features of the armor-plate frauds at Carnegie's, and expressed the opinion that not nearly all the facts relating to the case had yet come out.

Those who had hoped that all or even the worst of the matter had been made public now see that their hopes were vain, for revelations are now made which seem to show that the entire manufacture of armor plates at Carnegie's has been honey-combed with fraud.

Workmen who performed important operations upon plates kept for their own protection memorandums regarding the treatment to which these plates were subjected, knowing that, should any of these plates fail during a test, a scape-goat would be diligently searched for. Each armor plate being numbered and marked for identification it becomes an easy matter to trace any particular one, and thus certain specific and very important plates are named that have had holes plugged in them of such character and size as to make them nearly, if not quite, useless.

The charges involve officials of the works, and also show great carelessness or trustfulness upon the part of navy inspectors whose stamps are stated to have been used in some cases without their knowledge to stamp plates which were entirely below the requirements of the contract.

By the death of David Dudley Field, which occurred recently in New York, the world lost a man who, while a very eminent—a world-renowned lawyer, was also broad-minded enough to perceive that the practice of law should be radically reformed in the interests of justice.

The common law consists simply of a mass of decisions of courts extending from the dawn of civilization to the present time, and it is yet in a sense unwritten, so that in a given case no one can know what the law is until there has been a decision upon that particular case. "Mr. Field contended that the law should be compressed into a single book, where any man could go for himself and read his rights and duties according to the natural measure of his intelligence." This is, of course, in the interest of justice and the common people, especially poor people, but is against the interest of lawyers and was hence vigorously opposed by them. It was, however, more than a theory with Mr. Field, and he actually did accomplish very much in the direction of the simplification of legal procedure, and exerted a very important influence in this direction both in this country and abroad.

The cable announces that our amiable English contemporary, *The Engineer*, has published a letter which charges virtually that about all our designs of naval vessels, yachts and merchant steamers are stolen from England by means of bribery and other "ways that are dark and tricks that are vain," by which, as readers of *The Engineer* know, Americans are always endeavoring to make up for their sad lack of a knowledge of what they themselves want, or how to supply their wants when recognized.

At Washington naval officers say that the charges made in this anonymous letter are not worth replying to, which is probably true.

Master Mechanics' Convention.

The twenty-seventh annual convention of the American Railway Master Mechanics' Association will commence at Saratoga, June 18th, and headquarters will be Congress Hall.

Literary Notes.

STANDARD TABLES FOR ELECTRIC WIREMEN. With instructions for Wiremen and Linemen; Underwriters' Rules, and Useful Formulas and Data. By Charles M. Davis. Fourth Edition, thoroughly revised and edited by W. D. Weaver.

The subjects contained in this little book of 127 pages are outlined in its title page, as given above. We believe it to be thoroughly reliable and practical in its data, and extremely useful to wiremen. The rules and hints are given in a concise manner, but not condensed to a degree as to render them ambiguous. An important section has been expressly prepared for this edition on the calculation of alternating current wiring, which brings this subject within the reach of practical men. The book can be easily carried in a pocket, and wiremen or linemen should not be without a copy. It is published by the W. J. Johnston Company, Limited, 167–176 Times Building, New York. Price, $1.00

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(198) B. M. W., Boston, Mass., writes: Kindly give me a little information through your columns. Does the point of a twist drill properly ground with the usual amount of clearance cut a flat surface, or does it cut a conical surface? *A.*—If the angle of clearance on both sides of the drill is the same, the point of a drill will cut a flat surface.

(199) D. J. C., Du Bois, Pa., writes: Is there any method for tempering small steel castings, say, from one to four ounces? They will need to be as hard as though made of tool steel. *A.*—If the castings are sufficiently high in carbon they will harden by the ordinary methods of hardening. If not, then by heating them in cyanide of potassium and quenching they will harden. It may be best to put them through the regular case hardening process.

(200) M., North East, Pa., writes: Kindly let me know through your columns if the process you give in question to Answer 133 for hardening cast-iron will harden cold rolled steel shafting. *A.*—No. In answer to Question 54 in our issue of February 1st, current volume, we have given a receipt for a liquid solution for case-hardening machine steel and wrought-iron. But for large shafting we consider this process impractical; for small work it gives satisfaction in many cases.

(201) J. F. F., ——, writes: Will you please give me a little information on the subject of calipers? I am an apprentice and one man will tell me to buy as light calipers as I can get; such as a firm joint or a solid forged spring caliper, in order to caliper accurately. Another will say that weight has nothing to do with it, and that I should buy an "up-to-date" caliper, such as the Stevens' "Ideal," or Fay's, or Stevens' "Reliable," etc. Will you kindly give me a little information on this point? *A.*—Those

who have been accustomed to use light calipers prefer them, while those who have been accustomed to heavier ones prefer those. It is largely a matter of individual choice, and the finest calipering can be done with either kind. Personally we should prefer the improved calipers you mention over the older styles which are not only lighter but not nearly so well made.

(202) X. Y., Schenectady, N. Y., writes: A friend of mine, who was fortunate enough to visit the World's Fair, informed me that he saw in the Machinery Hall, near the large basin, what he calls a vertical bilge pump, the discharge opening of which was square. He is unable to give me the maker's name, or place of manufacture. According to his belief this pump does same work with one third power required by some of the centrifugal pumps now in use. What I wish to find out is where and by whom the pump is made. I could think of no person, unless it was yourselves, who could give me the information desired. *A.*—The pump to which you refer is a centrifugal pump, made by Joseph Menge, of New Orleans, La.

(203) H. B., Schenectady, N. Y., writes: I am building an engine of the horizontal center-crank style, and would like to know if the following dimensions are about right: Cylinder, 1¾ inches diameter; 2½ inches stroke; steam ports, $\frac{8}{16}$ x¾ inch; piston rod, $\frac{5}{16}$ inch diameter; valve rod, $\frac{3}{16}$ inch diameter; connecting rod, 7½ inches long; shaft, $1\frac{1}{16}$ inch diameter; crank-pin, ½ inch diameter; fly-wheel, 8 inches diameter, 1¾ inches face. *A.*—The dimensions are correct with the exception of the crank-pin. For a center-crank engine we prefer to make the diameter of the crank-pin equal to the diameter of the shaft. If close regulation is required we should prefer a larger fly-wheel, but if this is not the object the size of fly wheel given by you will do. 2. How much power will the engine develop with 40 pounds of steam pressure? *A.*—Running at the rate of 450 revolutions per minute, and with a mean effective steam pressure of 40 pounds, the engine will develop about one-half horse-power.

(204) C. H. F., Boston, Mass., writes: I desire to use a block of rubber 4½ inches diameter, and 4½ inches long. It is to be used as a relief in case of excessive pressure. The rubber is to be compressed by means of a two-inch screw until the desired pressure is obtained, and anything in excess of this is to compress the rubber. What should you consider the practical limit? The excess of pressure should not compress the rubber more than ¼ inch, and it must recover that amount when the excess of pressure is removed. I should like to know about what pressure I might be able to obtain under the conditions given. *A.*—We do not know of any rules by which the compression of rubber under certain pressure may be computed, but we should judge that this particular piece of rubber will safely support a load, or resist a steady pressure of about 8,000 pounds. When the load is suddenly applied the pressure should not exceed one-half of the steady pressure. It will not be a difficult matter to determine the pressure for every ¼ inch compression by putting the rubber in a press.

(205) W. D. M., Garfield, O., writes: Suppose two lines are marked on a horizontal beam, one on the compression side, to represent, by its length, the crushing force; and the other line on the tension side of the beam, to represent the tensile strength. If now the opposite ends of these lines are connected by oblique lines on the side of the beam, will the latter intersect each other in the neutral surface of the beam? *A.*—If the lines drawn on the top and bottom of the beam (cross section being rectangular) represent the ultimate compressive and tensile strengths, the oblique lines on the side of the beam will not intersect each other in the neutral surface, because under these conditions the lines representing the ultimate compressive and tensile strengths will not be of equal length, and therefore the lines on the side of the beam cannot cross each other in the center line of the beam through which, in all practical work, the neutral surface passes. But when the lines on the top and bottom of the beam represent stresses within the elastic limit, then these two lines will be of equal lengths, and the lines on the side of the beam will intersect each other in the neutral surface of the beam.

(206) R., Hudson, Mich., asks: Will you please give me the formula for calculating the clearance for punches and dies for different thicknesses and kinds of metals? *A.*—We are not quite sure whether you mean the amount the die should be larger than the punch, or the taper which should be given to punch and die. What is known as the "Sellers rule" requires that the diameter of the hole in the die shall be equal to diameter of punch + ⅛ thickness of plate, or $d = p + .2\,t$, in which d = diameter of die, p = diameter of punch, and t = thickness of plate. Though this is especially for boiler plate and similar work, it is probably about right for nearly all kinds of work except such as is done on clocks and similar classes of work where accuracy with avoidance of distortion and burr are important. In such work the punch is made to just work freely within the die. As to the amount of taper given to punch and die, this depends upon the character of the work to be done, and can sometimes be decided only by an experienced man upon full knowledge of all the conditions. For boiler plate and similar work both punch and die may be given about one degree taper on each side. But for lighter work, especially in the softer metals, either the die or punch, and sometimes both, are made without clearance. It is a quite common practice when sheet steel is to be punched up to ¼ inch thick, as in manufacturing operations, to give the die only a very slight clearance, and the punch none at all.

(207) R. T. C., Allegheny, Pa., asks: Could you recommend a good book on molding and foundry practice—not an expert hand-book, but one adapted for general reference for patternmakers and draftsmen? 2. A book on the theory and construction of steam engines, embracing the most modern practice—not an expert hand-book, but a book adapted to one with a slight knowledge of mathematics and general formulas. 3. A book on geometry for practical reference. *A.*—"The Iron Founder," and "Iron Founder Supplement," by S. Bolland; "American Foundry Practice," and "Molders' Text book," by T. D. West, are good books. "Practical Treatise on the Steam Engine," by Arthur Rigg, is a good book and may suit your purpose. For geometry you need no reference book, as each elementary geometry is a reference book. If you have not studied geometry, we should strongly advise you to do so, as it will lay a good and the only foundation for subsequent mathematical studies. It is a mistake to seek a royal road to learning, as such is sure to lead to failure. 2. You published some years ago some examples of how to form knots, splices, etc., kindly state the date of that issue. *A.*—October 29, 1891. 3. You also published a series of articles on rubber pattern work. Please give me the dates and price of these numbers. *A.*—October 15, December 17, 1891; February 18, March 17, May 12, October 6, December 1, 1892, and February 23, March 2, 1893. The numbers prior to 1893 are not in stock—we cannot furnish them; those in 1893 we can furnish at 6 cents each.

(208) N. L. C., Norwich, Conn., writes: I would like to know some rule for finding the horse-power of a machine. I mean some simple rule that will not require a knowledge beyond ordinary arithmetic. If there is one, please let me know through your columns. *A.*—We suppose you refer to the power required to drive machines. There is no simple rule for this purpose. The power required to drive machines can frequently be estimated by the driving belt, speed, and diameter of the pulleys. If the pulleys are of equal diameters, the power which a single belt can transmit is found by the following formula:

$$H = \frac{D \times R \times W}{2{,}750},$$

in which H = horse-power, D = diameter of the pulleys in inches, R = revolutions per minute, W = width of belt in inches. For double belts

$$H = \frac{D \times R \times D}{1{,}925}.$$

If the pulleys are of unequal diameters, the above rules should be slightly modified by using the following divisors in place of those given above. When the arc of contact of the smaller pulley is

	For Single Belts.	For Double Belts.
¼ of the circumference, use	6,080	4,250
⅓ " " "	4,730	3,310
⅜ " " "	4,400	3,080
⅔ " " "	3 850	2,700
⅝ " " "	3,410	2,390
⅞ " " "	3,220	2,250

(209) S. H. R., Norristown, Pa., asks: By whom was the 20 horse-power steam turbine built, exhibited at the World's Fair? *A.*—By Dr. G. DeLaval, of Stockholm, Sweden. 2. Does this steam turbine actually work with economy approaching that of a good triple expansion engine? *A.*—It is claimed that these turbines will work with an economy equal to that of triple expansion engines of corresponding power, but we have not yet seen any reports of tests. 3. Do you know of any of these machines in actual service? *A.*—No. 4. Are there any books published giving clear directions for building and repairing small electric motors? If so, please give titles. *A.*—"Dynamo and Motor Building, with Working Drawings for Amateurs" is a good book; it describes the method of building dynamos and motors. It is published by The W. J. Johnston Co., New York. "For Repairing, Practical Management of Dynamos and Motors," by F. B Crocker and S. S. Wheeler will be of aid. It is published by D. Van Nostrand Co., New York. 5. Can machinists of ordinary education easily understand books of this kind? *A.*—With a little study machinists should understand these works, but a knowledge of the elements of electricity and magnetism, previously obtained, will be of great assistance, enable the reader to make faster progress, and in the end will be better pleased with his labors. 5. In the best practice what number of feet is found to give the best results in quantity and quality for planing medium hard cast iron? *A.*—That depends on circumstances, and no rule for determining the speed to suit all cases can be given—about 18 feet per minute is a common practice.

(210) M. M. P., St. Hyacinthe, Can., writes: Please give me the standard size of shafting; I mean, what should be the size of a shaft turned from a 2 inch bar? *A.*—The standard size of shafting turned from bars is $\frac{1}{16}$ inch less in diameter than that of the bar. The above does not include cold-rolled iron, as this is rolled to size, and is not turned. 2. What is the standard size of key-ways? *A.*—It can scarcely be said that there is a regular standard for keys, but the most popular one, and probably the most frequently used, is: Breadth of key = ¼ of diameter of shaft + ⅛ inch; thickness of key = ⅛ of diameter of shaft + $\frac{1}{16}$ inch; depth of key-seat in shaft equal to depth of key seat in the hub, measured on the center line of key, not on the side of key; taper of key ¼ inch to the foot. 3. What is the standard for boxes for shafts? *A.*—There is no standard. 4. What size of belt will I require to transmit 10 horse-power? *A.*—That depends on the speed of belt and the difference in the diameters of pulleys. 5. Please give rule for computing the size of shafts for transmitting a given horse-power. *A.*—For head shafts supported by bearings close to each side of the main pulley or gear so as to wholly guard against the transverse strain, the following formula will give ample strength:

$$D = \sqrt[3]{\frac{125 \times H}{R}},$$

in which D = diameter of shaft in inches, R = revolutions per minute, and H = horse-power. For line shafting from which power is taken at intervals, bearings 8 feet apart,

$$D = \sqrt[3]{\frac{90 \times H}{R}}.$$

For simply transmitting power and short counters,

$$D = \sqrt[3]{\frac{50 \times H}{R}},$$

in which the letters denote the same quantities as in the first formula.

(211) C. A., Buffalo, N. Y., writes: I have had an argument with a boiler maker, a man of considerable experience, who says that theory is not practical, and that it cannot be relied upon in practice, and that in bridge work and boiler work drawings and figures cannot be relied upon. My view of the matter is that any supposed theory which does not turn out right is not theory at all, that theory is practical which makes a foot 12 inches in a bridge, boiler, engine or building; if the correct dimensions are written on drawing and the parts of a machine or structure made to these dimensions, these parts will go together perfectly. Now, I have heard many machinists say the same thing as this boiler maker. What is your view of it? *A.*—You are perfectly right in your opinion. A boiler maker who insists that drawings are of no use and cannot be relied upon, must have had a very limited experience, probably not extending beyond country shops or places where one class of boilers is made from one year's end to the other. We know there are mechanics who do not know the value of a drawing, but these are usually men either without ambition, or who have had no opportunity in finding out the value of a drawing. Before a bridge of any importance is built the stress and strains in each member are carefully considered and worked out, then the drawing is made, and after this the bridge is built in exact accordance with the drawing. For building marine engines and boilers, drawings are indispensable, and many manufacturers would have to go out of business if they could not rely on their drawings. From a mechanical standpoint, we may say that theory is an intelligible conception based upon correct observation of how something has been brought about, and how similar things should be done in the future; such theory must agree with practice. There are theories which simply originated in the mind without any support of observation, theories of this kind are frequently opposed to facts, and when put to a practical test are found to be worse than useless. For instance, the theory adopted by perpetual motion cranks belongs to the latter class of theories.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Speed Gage McLauthlin & Co., Fulton St., Boston.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Engine Castings, 1 to 6 Horse-power Vertical. Humphrey's Foundry, Bellefontaine, O.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N.J.

M. E. Howard, Indianapolis, Ind. Specialty, 4 and 8 H. P. engines in stock, write for price.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Wood carving for amateurs, illus., post free, 40 cents. Spon & Chamberlain, 12 Cortlandt street, New York.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

American Packing Rings make pistons steam tight. Are simple, durable and inexpensive; write for circular. J. H. Dunbar, Youngstown, O.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co. New York, N. Y.; Cincinnati, O., & Stroudsburg, Pa.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

Testing Machines and Methods of Testing.

Wednesday, the 11th inst., the day and evening were very stormy, and this, together with the fact that the notices of the meeting reached members rather late, reduced the attendance at the monthly meeting of engineers somewhat, though there were probably as many as forty present.

Mr. C. W. Hunt presided, and the first thing done was the reading of two letters written by members not present. One of these had no bearing upon the subject under discussion, but that of Mr. E. D. Estrada, of Pittsburgh, was addressed to Mr. Hunt, and was as follows:

"As it will be impossible for me to attend the meeting of April 11th, when the subject of 'Testing Machines and Tests of Materials' will be discussed by the members of the society, I avail myself of the invitation issued by the committee, and submit herewith the following remarks, trusting you will kindly read them to the members present: There is no subject in engineering which has such an extent of unexplored ground as that relating to the resistance of the materials used in engineering construction. Our present knowledge of the subject is based on the results of experiments devoid of any scientific value, notwithstanding that some text-book authors and experts affirm the contrary. What scientific value, for instance, can a determination of the 'elastic limit,' have, when, in the first place, we do not know what it is (see text-books on the resistance of materials), and, in the second place, we have no

standard method of determining it? The lack of a standard method of testing, a standard form of specimen, and a standard unit of measurement, is the cause of much mystery in this branch of our profession. There are some of you, no doubt, who believe that the ultimate tensile strength of wrought-iron and steel is increased by straining the material permanently, and then allowing it to rest. Experiments have that if any new steps have been taken for the purpose of determining the physical properties of iron and steel, they have been directed in a new path, leading backwards, rather than forwards. The time when a test specimen was required to have opposite sides parallel is rapidly passing by, and to-day we find some of our most distinguished inspecting engineers accepting without a murmur such tension specimens Mr. Tinius Olsen, of Philadelphia, as follows:

Mr. Chairman and Gentlemen: The improvements which I more particularly propose to describe to-night, will be better understood if the design of the machine, to which they are so far applied, is shown. Our first view is, therefore, of a machine as it is now very generally used in the rolling mills, steel works and other industrial establishments. crosshead B rests upon four quarter-section columns A, which are supported on the scale platform E. Platform E rests on the scale levers F F', which communicate the pressure exerted on the platform E through the intermediate lever F^2 to the beam where the pressure is balanced and recorded. In many machines the adjustment of the poise q is done by the operator turning a hand and cord, or a belt wheel placed in front of

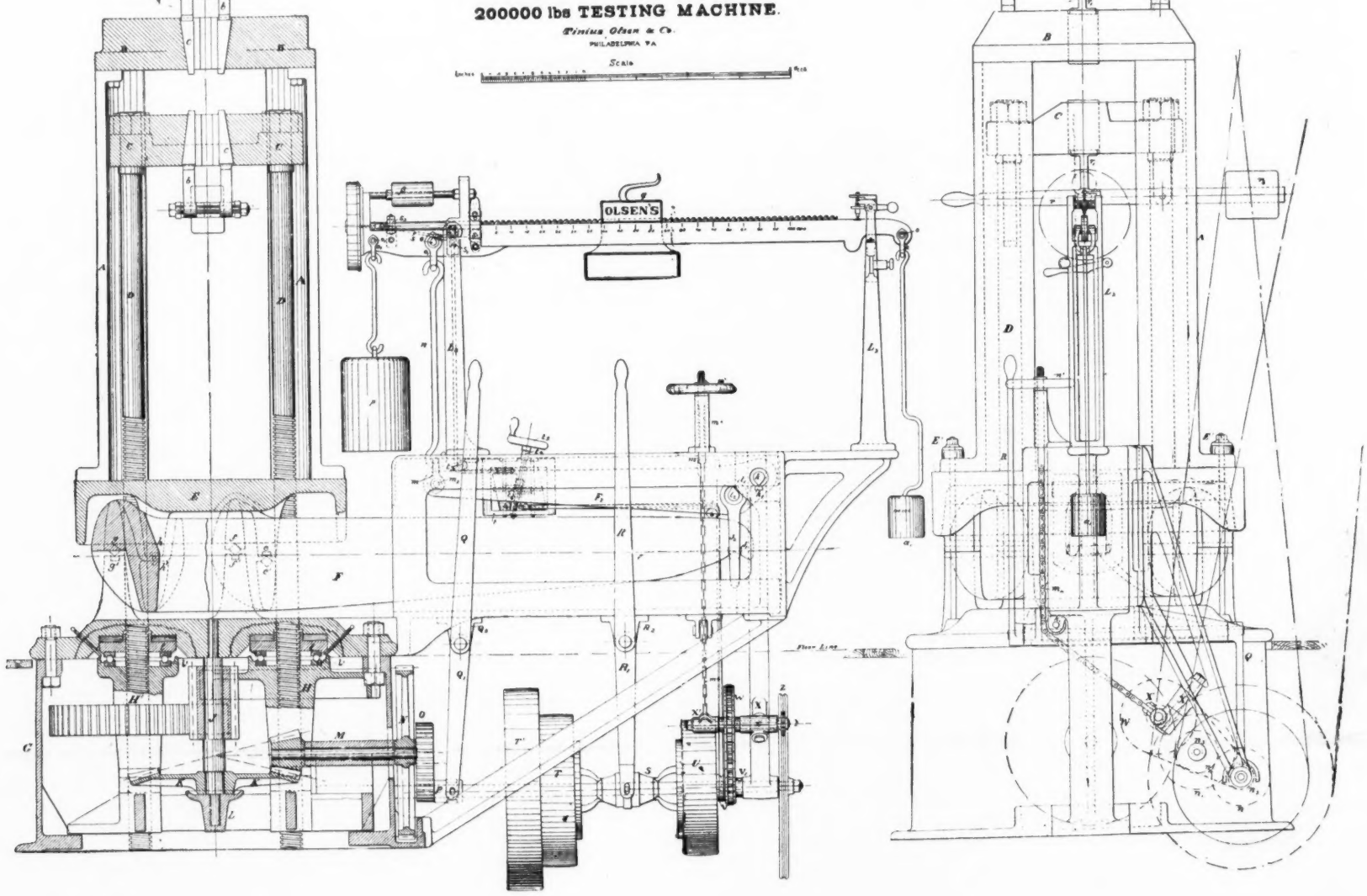


Fig. 1.

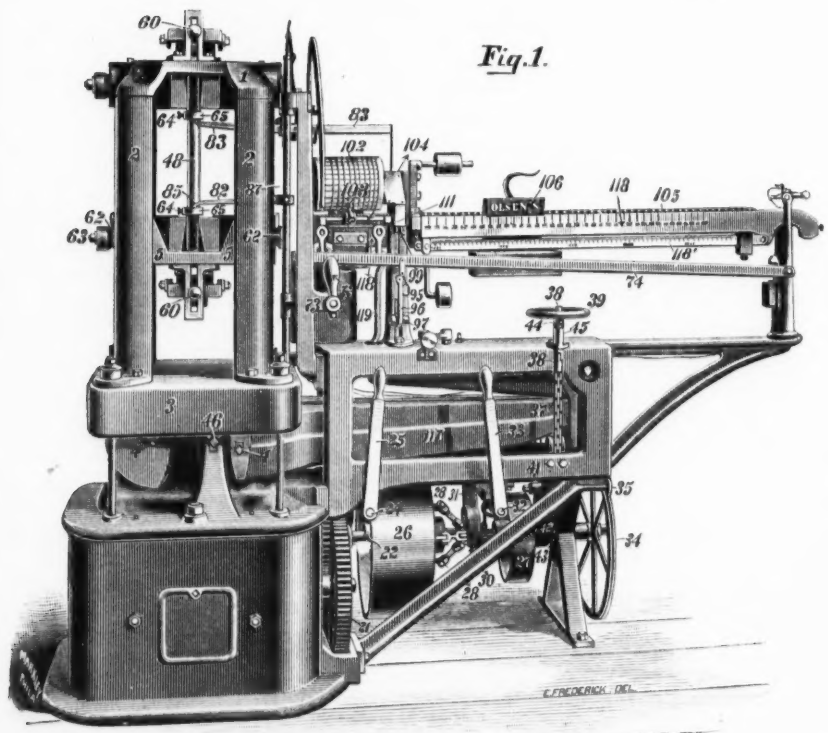
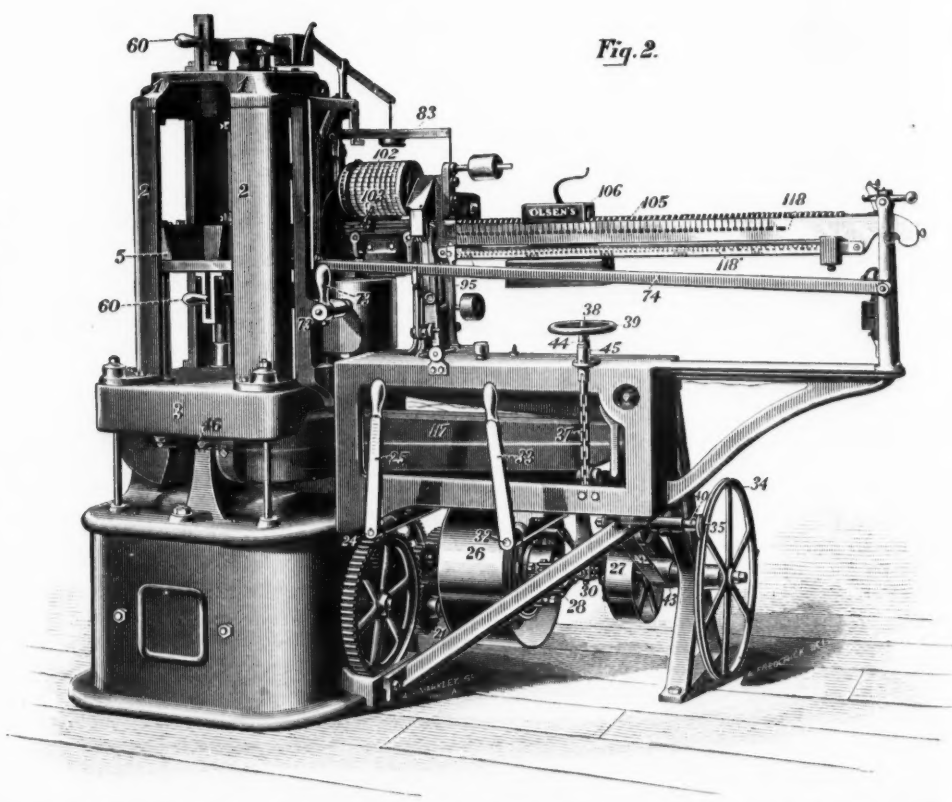


Fig. 2.



been made, and to some minds it has been shown conclusively, that such is the case. But let us ask the question, were the conditions under which the specimens were permanently strained and then allowed to rest, the same as those under which they were finally broken? We are left without an answer. How can we then attribute the increase in ultimate strength to rest?

"It is, indeed, lamentable to acknowledge as are shown in the inclosed sketch. These are not exceptions, similar ones are tested here every day by the hundreds, and who knows but some of the results thus obtained have gone to form part of experimental data in the establishment of principles. If a man is foolish enough to accept such specimens, there is no telling how many different conclusions he may draw from the results." Then followed a paper by

The ends of the specimen to be tested are secured in the crossheads B and C, by the wedges operated and placed in the proper position by the balanced lever r. The lower movable crosshead C is secured to four screw-threaded rods D, to which a vertical motion is imparted by a train of gearing in the base of the machine, and same is operated by power from the countershaft and pulleys J and U. The upper the stand L^3. In the view before you, however, the arrangement is shown for the automatic movement of poise q, which is now used in many places. The automatic movement is accomplished by a belt driven from the hub of pulley U at V; this belt runs vertically to, and over guide pulleys Q, then horizontally to the speed-regulating cones 1^1 and 1^3, from cone 1^1 a small, round belt transmits the motion over guide pulleys

1³ vertically to the pulley S', which turns a shaft in a bracket secured to the beam; the grooved pulley S being so placed that the belt pulls exactly in line with the balancing pivot of the beam, and thus any irregularity in the tension of the belt during the test has no effect whatever on the sensitiveness or operation of the beam. From the pulley and its shaft S the motion is further transmitted to a small friction pinion, in the dial casing 3; this friction pinion is in constant motion during the operation of the machine. On top of the beam is seen one-half of a very large pitched screw, 4, for moving the poise; this screw is extended into the casing, 3, and on the end is secured a large disk and dial which

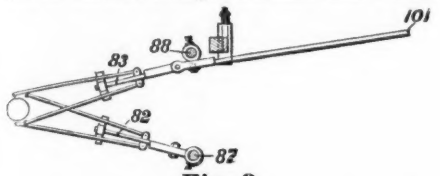


Fig. 3.

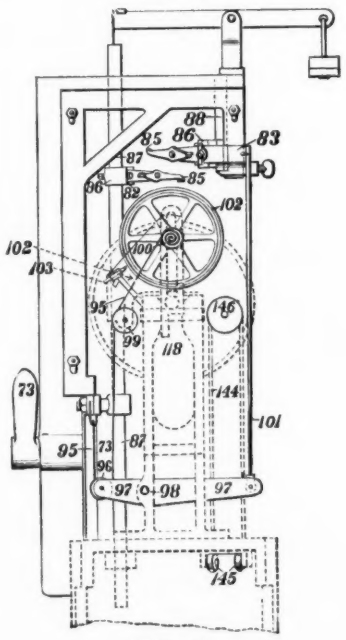


Fig. 4.

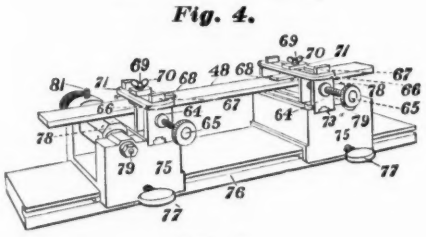


Fig. 5.

shows to the operator the smaller and fractional readings of the stress exerted on the specimen. The dial plate which is secured to the end of screw, 4, is made to revolve by causing contact between it and the constantly running friction pinion, thus turning the screw, 4, which moves the poise q on the beam. This contact is effected by a lever, one end of which is the bearing for the friction-pinion shaft, the other carrying an armature for an electro-magnet at 5, the vibration of the beam making or breaking the current at 6, for the electro-magnet. When the beam raises, due to additional load, the contact is made, armature attracted, pinion put into gear, and the poise q moved forward until the beam descends and the contact is broken; at the same time the contact between the friction pinion and the dial plate breaks. Thus far, then, we have the machine for recording the amount of stress at which a specimen breaks. There are, however, other points of information about the material tested, which are of just as much or even greater importance for the engineer to know, such as the yielding point, and the elongation or the change of dimension of the sample tested. This data, especially the point at which yielding commences, is and has been obtainable in a very crude and unsatisfactory way, and in a great measure has been left entirely to the discretion of the operator, there having been no means for its correct determination for practical use. The drop of the beam, which is used, and is very marked for many soft iron and steel specimens, is for others not so marked, for still other grades and compositions of materials utterly untrustworthy. To make the machine indicate, clearly and unmistakably, this point or these points has been my object for many years. About half a dozen different systems for this purpose have been more or less completed, but laid aside, not because each system would not work, or could not be made to work, and thus in a great measure accomplish the object in view; but mainly because they became too complicated or were too liable to get out of order, or took too much time in their application to be of any practical value. From each attempt, however, some valuable points were gained which finally suggested and helped to develop, not only the best, but the least complicated of them all, and this device seems to be practically all that can be desired for the purpose. It is simple in construction, easy to understand and handle, always ready for use, quick in its application, and not more liable to get out of order than any other part of the machine, as well as of universal use, that is, applicable to the various classes of tests.

I will now describe this device. In the illustrations, Figs. 1, 2, 3 and 4, the reference marks correspond. On top of the beam is mounted the cylinder or drum, 102, which can revolve on its axle; to this drum is attached a sheet of paper, on which the object is to have the mechanism trace a diagram or curve line which will at the same time show both the stress and the amount of yielding of the specimen.

A pencil at 103 traverses the drum and paper in the direction of its axis; it is moved by the same screw which moves the poise, 106, consequently any movement of poise also imparts to the pencil a corresponding amount of motion in the direction of the drum's axis; these distances form the ordinates to the traced curve and represent the stresses.

The other motion necessary to trace the line forming the curve (which will be the abscissæ representing the yielding of the specimen), is accomplished by revolving the drum corresponding to such yielding.

This yielding motion of the specimen is transmitted to the drum as follows: Starting at the specimen, 48, Fig. 1, two collars, 64, are placed upon it at a certain distance apart, say 8 inches, as now generally adopted.

Fig. 6.

Fig. 7.

On the under side of the upper collar, 64, are fingers, 83, one on each side of the specimen, so arranged that they will transmit the central motion of the specimen to the arm, 83, arm 83 being pivoted for vertical motion at 88, Fig. 4; any vertical motion of the specimen or upper collar is thus transmitted to point 101, then further communicated by a cord or steel band to one end of the lever, 97, which is pivoted at 98. This lever, 97, is placed in a vertical plane under the edge of the balancing pivot of the beam.

Starting again at the specimen, on the lower collar, 64, is placed another pair of fingers, 82, which, in the same manner as the upper fingers, transmit any vertical motion of the specimen to the vertical rod, 87, Figs. 1, 3, and 4. The lower fingers, 82, can be adjusted anywhere along the vertical rod, 87, so as to be in proper place for the length of specimen operated upon.

The vertical rod is attached by a pivot to one end of the bar, 74; the other end is supported on a pivot at 50, and at a point 99 on this bar in the vertical plane of the balancing pivot of the beam is attached a band or cord, 95, which first runs down and over a pulley, 96, in the end of the lever, 97, then up and over the guide pulley, 99, to the enlarged part of the shaft, 100, for the recording drum. Thus the vertical motion of the specimen or the lower collar, 64, on the specimen is communicated to the recording drum, imparting motion to it, or allowing same to turn on its axis.

The function of lever, 97, whose one end is connected to the fingers resting against the upper collar on the specimen, and the other end, in which is the pulley, to the fingers resting on the lower collar, is, to separate the motion that takes place by the specimen as a whole, from that motion which takes place in it and only between the collars, or to retain for transmission to the recording drum, only what may be termed a difference of motion, the motion taking place either in or by the heads of the specimen not being transmitted to the drum.

The function of lever, 52, and counterweight, 53, Fig. 3, is to balance the whole system of parts, so as to make it sensitive to the smallest variations of motion.

In Fig. 5 is shown an arrangement of adjustable heads for parallel specimens, as well as a device for placing these heads on the specimen quickly and in the desired proper position.

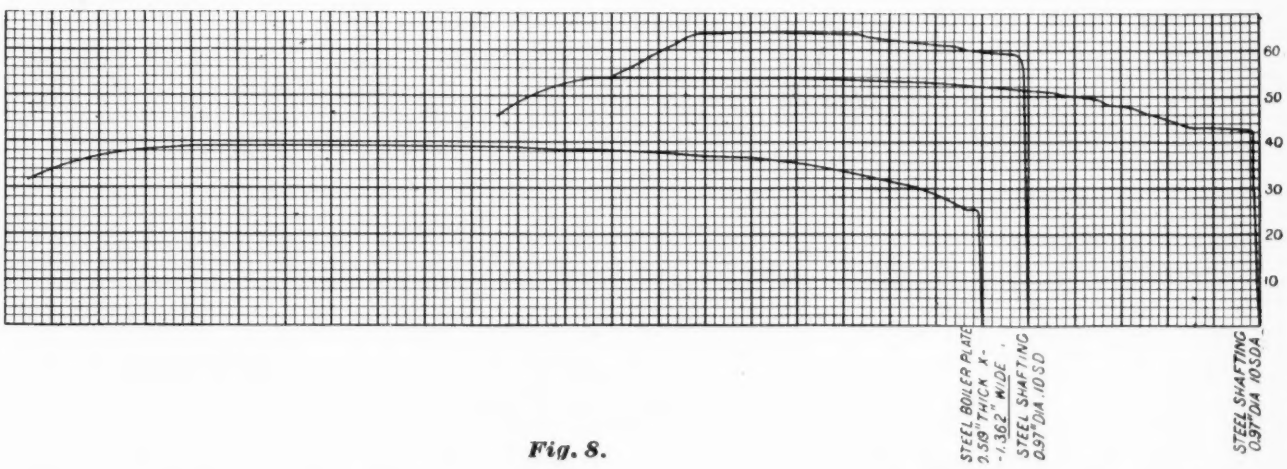


Fig. 8.

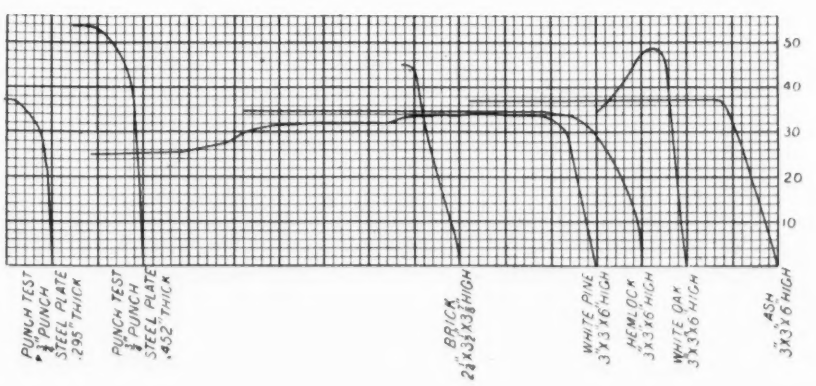


Fig. 9.

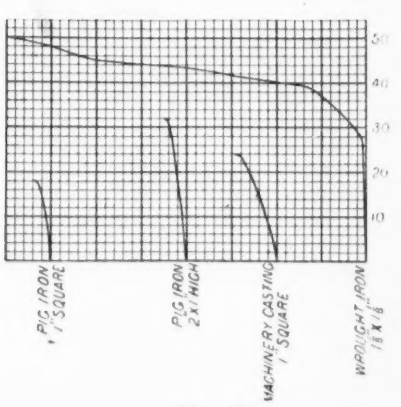


Fig. 10.

The next three figures show this arrangement very plainly, the two at the top being two different kinds of heads, and the lower figure the setting device with the specimen and the heads on the same, ready to be placed in the machine.

[Mr. Olsen then threw upon screen views of other machines similar, and which lack of space forbids our illustrating.]

Having now shown and described the device and the machine to which it is applied, the next view will show diagrams as traced in the machine. The card (Fig. 8) is of tensile diagrams, Nos. 1 and 2 of steel shafting, No. 3 of steel boiler plate.

The next card (Fig. 9) is of tests in compression, as traced on the machine, No. 1 of ash, No. 2 of white oak, No. 3 of hemlock, No. 4 white pine, No. 5 brick, No. 6 a punch diagram (⅝ inch punch through ½-inch steel plate), No. 7 another punch diagram.

The card (Fig. 10) contains diagrams of transverse tests, No. 1 of wrought-iron, No. 2 general foundry iron, Nos. 3 and 4 of pig-iron.

In this last view [not reproduced] is shown a wire-testing machine, recently designed and finished, in which the graphical system, as before described, is considerably altered and modified. Having for some time had much inquiry for wire-testers that would test quickly, as well as furnish more data of the test than those hitherto in use, this subject was taken up and resulted in a machine as the view represents.

In this design the automatic operation of the beam enables the operator to do more than twice the amount of work performed on previous machines in the same time. In the graphical arrangement . . . the diagram paper is placed on an inclined table in front of the operator. The tracing of the pencil in this case, when such quick work is calculated to be done, will be used mostly for notifying the operator when to read the figures on the beam for the yielding point, as well as for quick reading of elongation, as no mark is put upon the wire before it is placed in the machine, the elongation is taken from the card which is the distance traveled by the pencil in the direction of the abscissæ. The full test covering, the yielding point, elongation and ultimate strength can be obtained on this machine in less time than it takes in the older machines simply to arrive at the ultimate strength of the wire.

I will not go more at length into the details of this machine, nor into the further extension of the system we are just perfecting, and which promises well for a still greater refinement, which in time it will easily cover, that is in reference to the line within the elastic limit for tensile and compression tests, the time for preparation was too short, and it would also have taken too much of your time this evening.

Some discussion ensued which we will give an abstract of later.

Core-rod Cutter and Shear.

We illustrate herewith a hand shear intended especially for the foundry core room or other place where wire or rods are to be cut up. It will cut round iron up to ⅝ inch diameter with ease. The gauge can be set at any length up to 15 inches.

Shear blades are 4 inches long and are arranged so they can be readily removed for sharpening.

The handle is of malleable iron 15 inches long, and the arrangement is such that ample power is secured for the heaviest work the machine is intended for. It is intended to be fastened to the bench, weighs 30 pounds, and is made by the Springfield Machine Tool Co., Springfield, O.

Manufactures

The Chemical Association Works will enlarge its plant at Rumford Falls, Me.

The Wyoming (Pa.) Electric Light and Power Company will establish a plant. The company is capitalized at $5,000.

Henry C., Joseph W. and Edward Lambert, Kansas City, Mo., have incorporated the Lambert Bros. Manufacturing Co.

Business is improving with the J. B. Allfree Company, of Indianapolis, which is increasing its force and number of working hours.

The Meriden Machine Tool Co., Meriden, Conn., report that business is still improving, and they are now compelled to run their shops nights.

Mr. L. J. Pender has removed his Boiler and Sheet-iron Works from Union City, Ind., to Hamilton, O., where it is his intention to increase the business.

The McNeal Pipe and Foundry Co., of Burlington, N. J., have placed the contract for two cleaning sheds with the Berlin Iron Bridge Co., of East Berlin, Conn.

Messrs. Russell & Co., the well-known engine builders of Massillon, O., have established a branch house at 1427 Manhattan Building, Chicago, Ill., and have placed Mr. J. S. Stephens in charge of the business at that point.

The firm of Joseph Edwards & Co., mechanical engineers, doing business at 412-416 Water street, New York City, have dissolved, and Mr. Joseph Edwards will hereafter conduct the business at the same place.

The Commercial Electric Company, of Indianapolis, reports business steadily improving. Last week the company shipped several large plants.

The M. E. Howard Machine Works, Indianapolis, Ind., report an increase of inquiries and sales of their specialty, which is a small vertical engine, and that they look for a much better year's business than they have had heretofore.

The Egan Co., of Cincinnati, O., are authority for the statement that the band re-saw is fast displacing the circular re-saw for re-sawing lumber, on account of the thinner kerfs made by the band re saw and the simplicity of the machine itself.

The laundry, kitchen, engine and boiler rooms for the Green Island Improvement Company's new hotel, at Lake George, N. Y., will be built of iron fire-proof. Warren & Bacon are the architects. The work is to be furnished by the Berlin Iron Bridge Co., of East Berlin, Conn.

The Delaware, Lackawanna & Western Railroad Co. have placed the order for two engine house roofs with the Berlin Iron Bridge Co., of East Berlin, Conn. Both roofs will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

We have received a well printed and well illustrated catalogue of Messrs. J. H. Sternbergh & Son, Reading, Pa., manufacturers of bolts, nuts, washers, rivets, lag screws, turnbuckles, track bolts and rods for structures. The catalogue is very complete and gives full information regarding the entire line of manufacture.

The Wyckoff Harvester Company has been organized at Jamestown, with a capital stock of $100,000. The company has obtained possession of the Wyckoff manufactory of agricultural implements at Perry, N. Y., and will remove the establishment to Jamestown. Five acres of land have been bought, and buildings will be erected at

MECHANICAL BOOKS.

We publish several mechanical books neatly bound in leatherette and which are authorities on the subjects treated. They are written in plain language. We have sold thousands to engineers. They are not filled with advertisements like most books of this class.

Key to Engineering, 92 pages, 30 cents. Plain questions and answers about steam.
Engineers' Epitome, 135 pages, 50 cents. More mathematical, with formulæ.
Common Sense in Making Steam, 60 pages, 25 cents. For owners of steam plants.
The above three post-paid for $1.00. Stamps taken.
Engineers' Catechism, 192 pages, 25 cents. We have bought the copyright of this book, which is an authority, and was compiled for engineers about to pass examinations.
Key to Engineering (enlarged), 174 pages, 50 cents, containing additional chapters and tables.

Following are from Practical Engineers, unsolicited.

I ENCLOSE ONE DOLLAR for a set of your grand little books on steam, and some day want some of the good steam appliances you make.—A. W. BELCHER, Rondout, N. Y., Feb. 4, 1893.

I WOULD NOT SELL "Key to Steam Engineering" and "Common Sense in Making and Using Steam" for $10 if I could not get another.—WM. D. REES, Pueblo, Colo., Sept. 24, 1892.

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W. B. MASON, Superintendent. WALTER G. CHASE, Treasurer.

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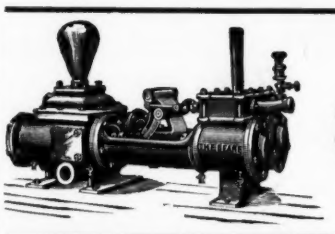
New York Office, 39 CORTLANDT STREET, ROOM 86.



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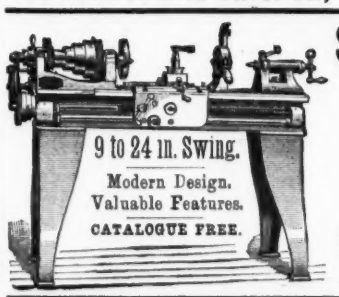

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SEBASTIAN LATHE CO.
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FOR SALE—GEAR CUTTERS.
One 48" Gleason Planer. One 42" Gleason Planer. One 72" Niles Rotary, Automatic Feed. One 36" Blaisdell, Hand Feed. All in perfect condition, good as new. Write for full descriptions and prices.
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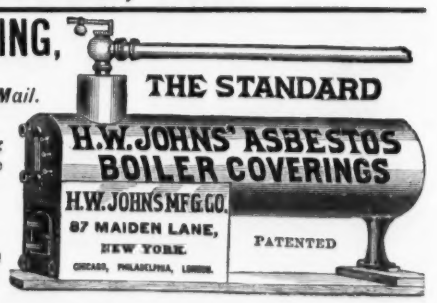
ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.



once. It is thought the plant will be fully established at Jamestown by the 1st of August, giving employment from the start to 100 men.

J. A. Fay & Co., Cincinnati, O., have issued a special catalogue of woodworkers' machinery supplies, shafting, hangers, pulleys, etc. This will undoubtedly prove a very great convenience to users of woodworking machinery, as it includes about everything required by them in the way of supplies, with prices, discounts, etc., is indexed and has telegram code. It is sent upon application.

The Whitman Agricultural Works, Auburn, Me., have more orders on hand than any previous spring since they commenced business. They are running the factory nights to fill pressing orders, and will be obliged to work over-time for several weeks. They laid plans to make 1,500 corn planters, 1,200 of which are already sold. They have orders for 7,000 wheelbarrows, and are doing a lively business in other goods manufactured by them.

Dr. Drysdale, of Philadelphia, Pa., has placed the contract for an iron roof over the new power house for the Hospital for the Insane, at Norristown, Pa., with the Berlin Iron Bridge Co., of East Berlin, Conn. It was desired that the roof be fire proof, and ordinary corrugated iron could not be used on account of the drip, so that the roof will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron covering.

We have received from the General Manufacturing Company, Bound Brook, N. J., a finely bound and illustrated catalogue of hydraulic machinery built upon the system and under the superintendence of Mr. Ernest W. Naylor. Complete hydraulic plants for boiler manufacturers, bridge builders, forgers, founders, etc., are shown, both in perspective and in detail, and the catalogue is a valuable one for all who are interested in this class of machinery.

The Hoppes Mfg. Co., Springfield, O., manufacturers of the well-known "Hoppes" feed water purifier, have received the contract for the purifiers to supply the boilers with pure feed water, for the City Electric Light Plant now being built by the Public Lighting Commission, of Detroit, Mich., the Hoppes purifiers having been selected after very strong competition. The order calls for seven 300 horse-power purifiers to carry 165 pounds of steam-working pressure. Each purifier is required to heat and purify 9,000 pounds of boiler feed water per hour.

Messrs. Curtis & Curtis, of Bridgeport, Conn., manufacturers of the Forbes patent die stocks, and all kinds of pipe-working tools and machinery, find that their labor-saving machinery and tools are coming into such general use abroad that they have decided to send out one of their firm to consult with their agencies, which are, scattered throughout Europe, and to look after their interests generally. Mr. Lewis B. Curtis expects to sail on May 16th, and will be absent about three months. They inform us that they are running their works with a full force, and are very busy with both foreign and domestic orders.

The Tradesman, of Chattanooga, Tenn., in its weekly review of the industrial situation in the South for the week ending April 16th, says: The prospect that the coal miners may go on strike at nearly all the Southern mines has temporarily somewhat unsettled the iron market at a time when it was beginning to steadily improve. An increasing demand for foundry irons has been followed by an advance in prices at the East. If Southern iron masters can obtain fuel supplies as heretofore, the outlook is encouraging. Well informed observers assert that the coal miners' strike will be a short one. A material reduction in freight rates on iron pipe to Northern and Eastern points has been announced, which will lead to a decided increase in the output, which has gained a high reputation for its quality. Mercantile business is good, but stocks of merchandise are very light. A system of buying only for present needs is well established in the South. Credits have been much shortened. Money is plenty at reasonable rates. *The Tradesman* reports thirty-four new industries as established or incorporated during the week, together with nine enlargements of manufactories, and twenty-seven important new buildings.

Machinists' Supplies and Iron.

New York, April 21, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.25; No. 2, $11.50 to $12.25; Gray Forge, $10.75 to $11.00. Southern brands are quoted at $12.00 to $12.50 for No. 1

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VARIETIES FILES
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JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
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WM. JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

C. W. LE COUNT,
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REDUCED PRICE OF LE COUNT'S
HEAVY STEEL DOG
Le Count's Heavy Steel Dog.
With Steel Screws, Lathe Made and Hardened.
When ordering, state as above, whether a full set or a set of 12, or small set of 8. Users of these dogs prefer them to any other make.
This Dog has a Very Heavy Boss, so that if the thread wears a Heavier Screw can be substituted.

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.66
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.95
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$21.60
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

One Small Set of 8—by 1-4 inches to 20 inch, - - $6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-2 in. to 4 in. 13.25
These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
LATHE
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

THE BERLIN IRON BRIDGE CO.
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CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
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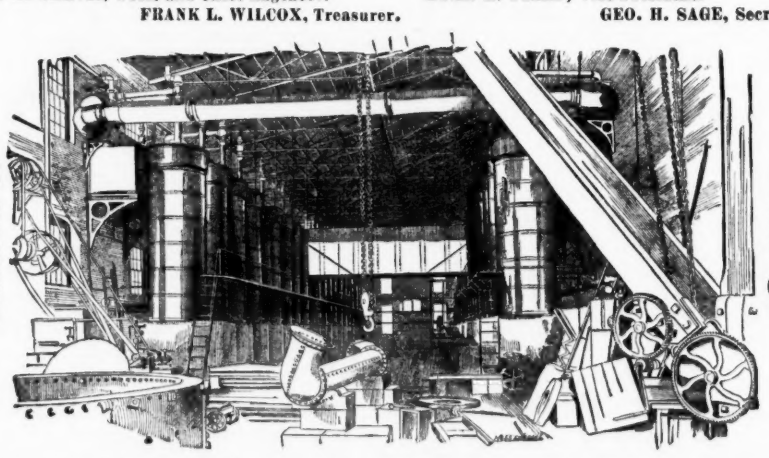
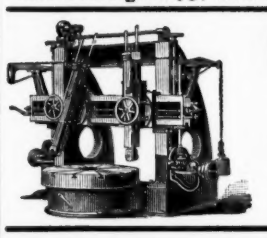
Engineers, Architects and Builders of Iron and Steel Bridges and Buildings.



The above illustration is taken direct from a photograph, and shows the interior of a Boiler House, the roof of which was designed and built by us for the Amoskeag Mfg. Co., at Manchester, N. H. The building is 75 feet in width by 275 feet in length, the walls being made of brick, and the roof being made of iron—iron trusses, iron purlins—and covered with corrugated iron, so that there is absolutely no woodwork anywhere about the building which can take fire. For boiler rooms this construction particularly commends itself.

SEND FOR OUR ILLUSTRATED CATALOGUE.



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MONITOR LATHES AND SCREW MACHINES.
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With Plain or Friction Geared Heads.
FORMING TOOL SLIDES,
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SPECIAL TOOLS AND FIXTURES.
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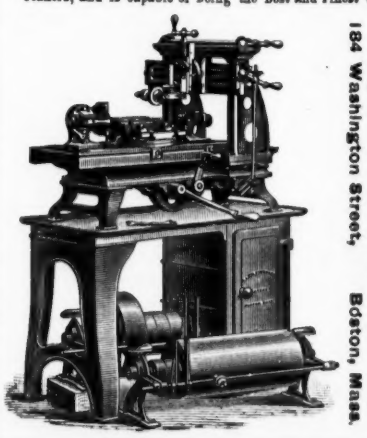
Circulars on Application. Mention AM. MACHINIST.

POWER OR HAND PLANER,
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.



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IT WILL PAY YOU to send for my circulars [illegible] prices.
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IRON CASTINGS—CASTINGS FOR ELECTRICAL APPARATUS.
The castings for many of the largest dynamos etc., of the General Electric Company are made by us. Orders are solicited for castings of this class. We have machine shop facilities for making special or experimental electrical machines.

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METAL-WORKING MACHINES
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Second-Hand Machinery
FOR SALE.
2 36 in. x 11 ft. Horizontal Stationary Boilers.
1 12 H.-P. Upright Engine (Greenfield).
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1 ¼ to 1¼ in. Open Die Bolt Cutter.
1 24 in. x 25 ft. Engine Lathe.
2 No. 2 Roots' Blowers.
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Also other Machinery at Low Prices.
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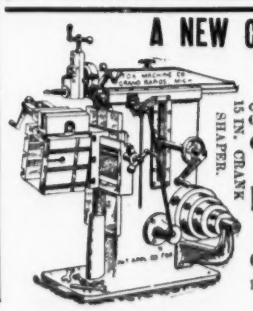
A NEW CRANK SHAPER.



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Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
Fox Machine Co.,
325 Nor. Front St.,
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MANUFACTURERS OF
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ROOTS' NEW ACME HAND BLOWERS
Slow speeded, Force-blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
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In Writing, Please Mention This Paper.

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ONLY APPARATUS that can MAINTAIN a VACUUM on ENGINES and ELEVATE the discharge WATER to TANK at any height.
This feature is appreciated by PAPER MILLS, SUGAR REFINERIES, COTTON and WOOLEN MILLS.
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ST. LOUIS, DENVER.

Foundry; $11.00 to $11.50 for No. 2, and $10.50 to $11.00 for No. 3.

Antimony—The market is dull and quiet. We quote L. X., 9¼c. to 9¾c.; Cookson's, 10c. to 10½c.; Hallett's, 8.65c. to 8.75c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 65c. to 66c.

Copper—The market has a weaker tendency. Lake Copper can still be obtained at 9.50c. The demand for home consumption and export is very light. Casting Copper is held at 9c. to 9¼c.

Lead—The market is firm at 3.47½c. for New York delivery. The official bullion quotation of 3.20c. has not been changed. The supplies are scarce, and the demand comparatively light.

Spelter—The market is unsettled and dull. Nominal selling rates are 3.50c. to 3.55c. for New York delivery, with 3.40c. bid.

Tin—The market is barely steady at 19.65c. for prompt delivery. Very little interest is manifested by buyers.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

A prac. mech., 8 yrs. foreman, wants pos.; age 34, habits A 1. Foreman, American Machinist.

Wanted—Position as foundry foreman; will furnish reference. Address W. J., Am. Machinist.

Young man, technical graduate, wants position in a mfg. concern Box 66, Am. Machinist.

A mechanical draftsman desires engagement. Address Staff, American Machinist.

Mech. eng., 7 years' prac. exp. shop and drafting office, wants position. S., American Machinist.

Wanted—A good brass pattern maker. Address P. O. Box 1,143, Ansonia, Conn.

Situation wanted by first-class patternmaker. Address La. B., American Machinist.

Wanted—A good machinist at once on light work; state experience. Box 752, Michigan City, Ind.

A mech. engineer, thorough machinist, good designer and draftsman, desires situation with growing concern; will invest $500. Advance, Am. Mach.

Mechanical engineer of large experience wishes position as superintendent, head draftsman or to travel for manufacturing concern, A1 reference. Box 55, American Machinist.

Young man desires position as assistant draftsman Has taken course in drawing at technical school; 7 years' experience as machinist. Money not the first object. Box 62, Am. Machinist.

Wanted—Position as foreman in iron foundry, one familiar with all kinds of light and heavy castings in green, dry sand, and loam; references from last employer. P. H. Fox, Am. Machinist.

Mechanical engineer lately graduated from a European school of technology, would like situation; has good knowledge of English, French, German and Italian. Box 64, Am. Machinist.

Molder wants position, well up in heavy engine and general jobbing work in dry, green and loam; age, 24; highest references from last employer. Box 65, American Machinist.

Wanted—By a first-class machinist and good draftsman, a position as foreman in a machine shop where there would be a good chance to work into something better; have held similar positions and can give the best of references; would prefer to locate in or near Minneapolis, Minn. Address Box 67, American Machinist.

Business opening—A superintendent wanted for a long established company building Corliss engines and heavy machinery specialties, a man having $10,000 to $25,000 to invest in the business and to take charge of the manufacturing department; only men well up in best methods of low cost work in machine shop and foundry and having record with successful companies will be considered. Address "Corliss," care Am. Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

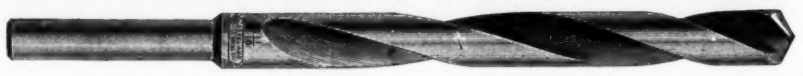
Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F. A. Welles, Milwaukee, Wis.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.



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COR. LAKE & KIRTLAND STS., CLEVELAND, O.

100 & 102 Reade Street, New York.
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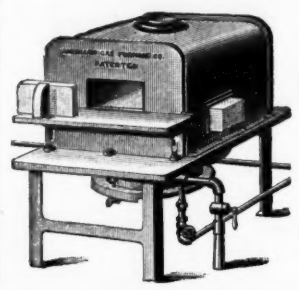

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Oil Gas Plants

GAS BLAST FURNACES AND HIGH PRESSURE BLOWERS

For the economical generation and systematic application of HEAT.

CATALOGUES ON APPLICATION.

No. 80 Nassau St., NEW YORK.

English Agency: {Chas. Churchill & Co., Ltd., 21 Cross St., Finsbury, London, E. C., England.

Second-Hand Machinery

MODERN STYLE, IN GOOD ORDER
BEING THE EQUIPMENT OF A
MACHINE TOOL SHOP
AND AN
ENGINE AND BOILER WORKS
WILL BE SOLD LOW BEFORE REMOVAL.

IRON PLANERS.

19 in. x 3 ft. Wheeler.
20 " x 4 " Lathe & Morse.
22 " x 6 " Wheeler.
24 " x 4 " Blaisdell.
24 " x 5 " New Haven.
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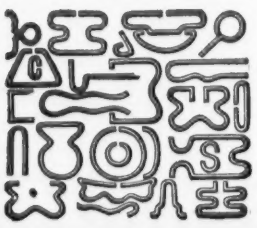

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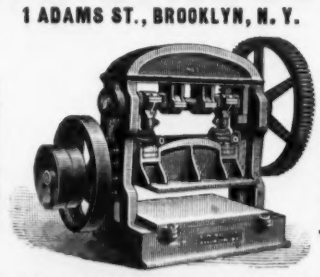

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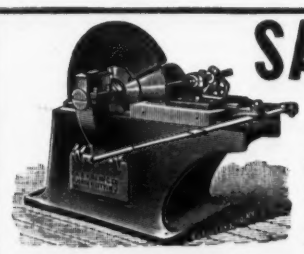

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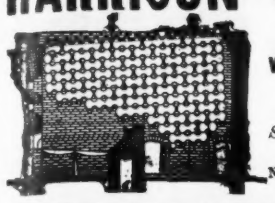

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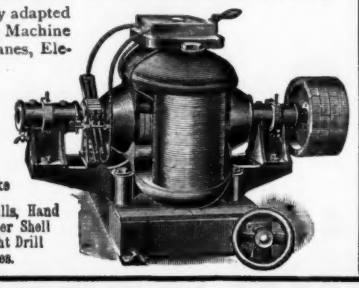

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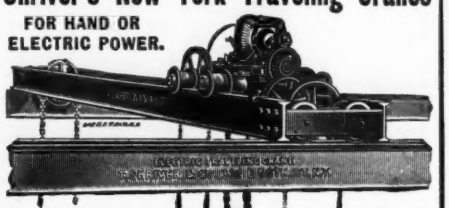

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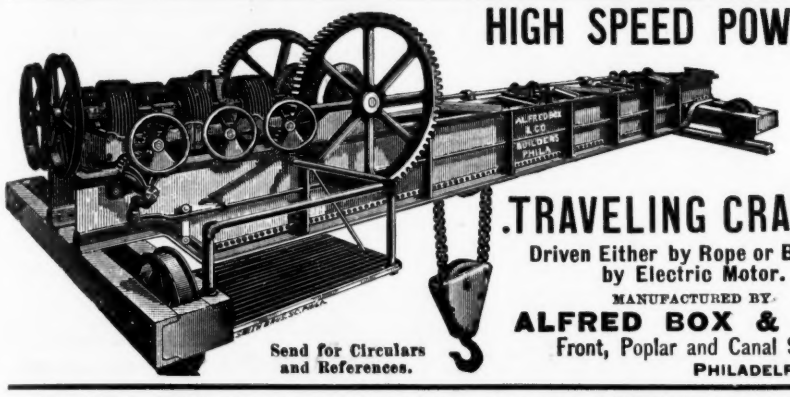

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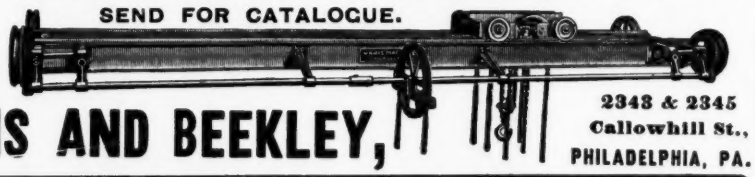

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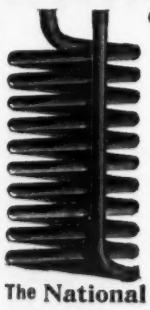

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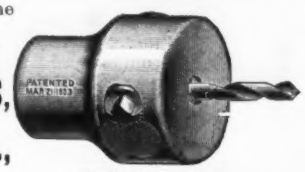

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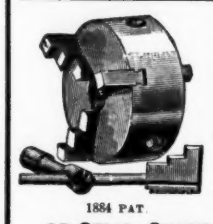

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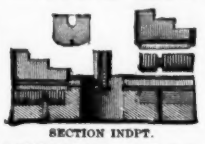

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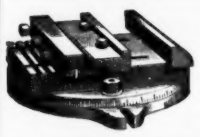

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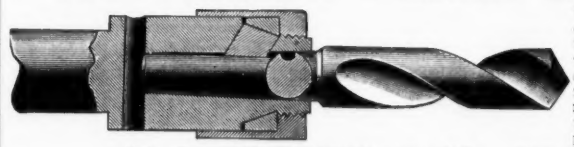

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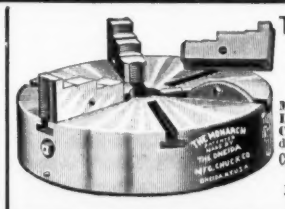

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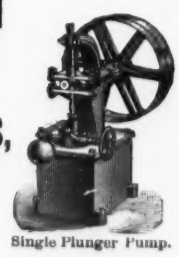

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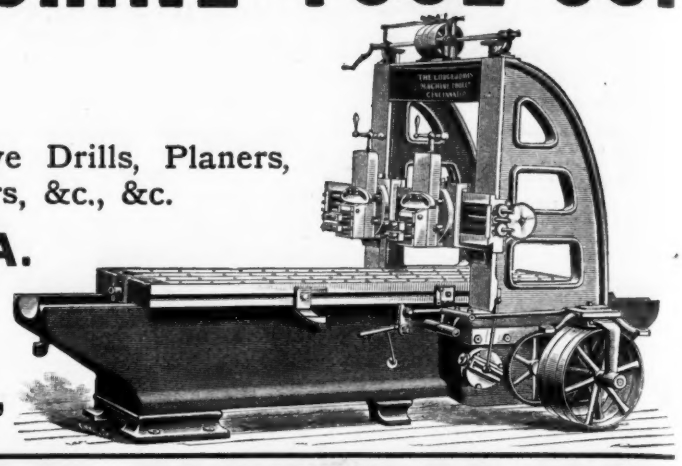

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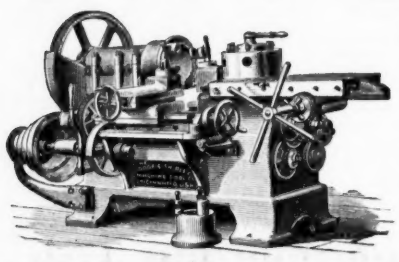

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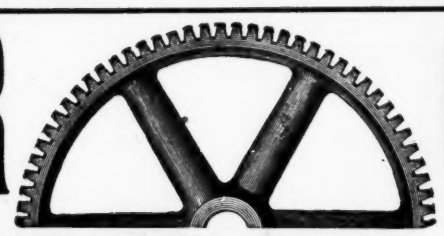

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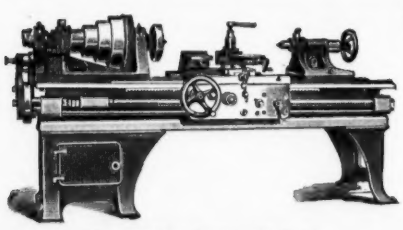

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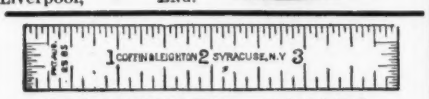

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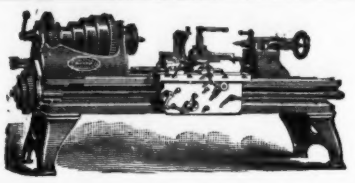

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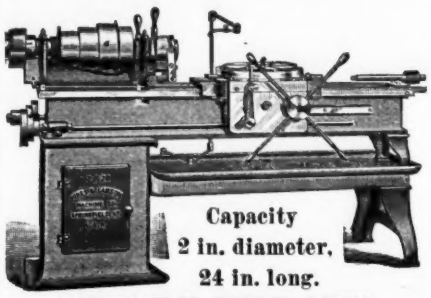

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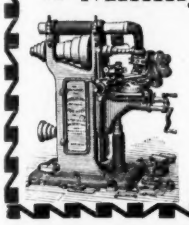

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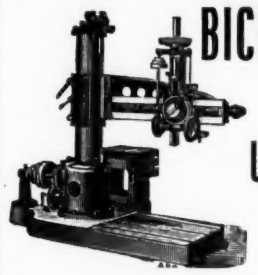

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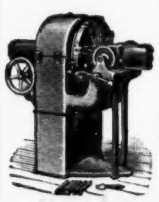

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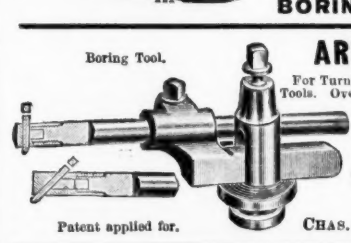

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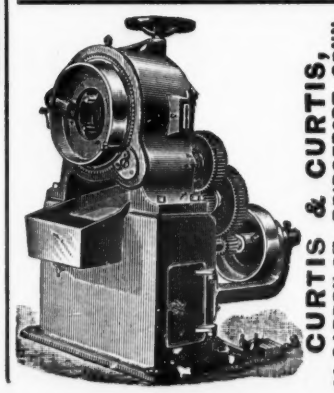

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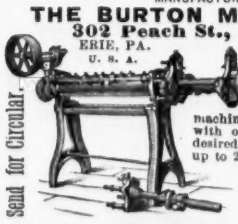

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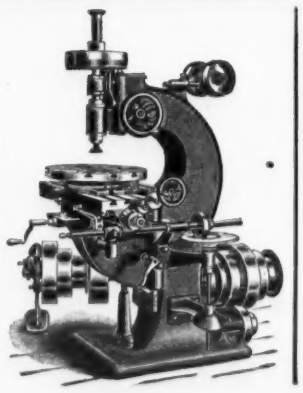

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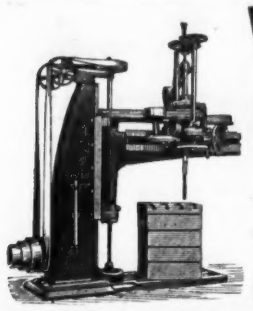

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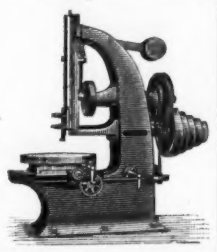

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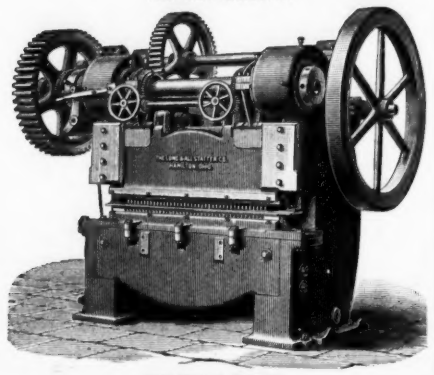

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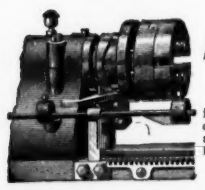

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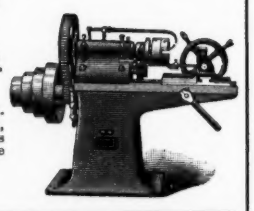

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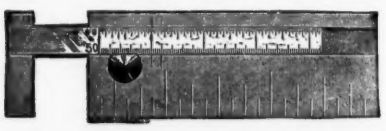

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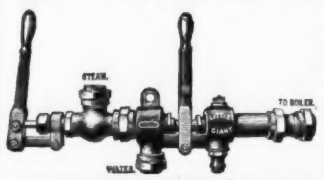

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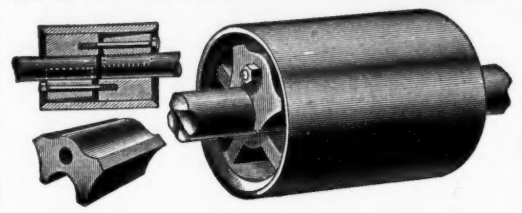

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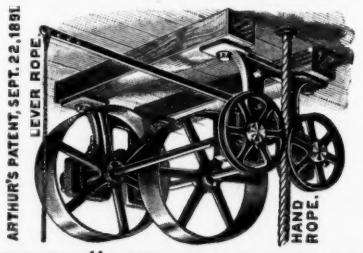

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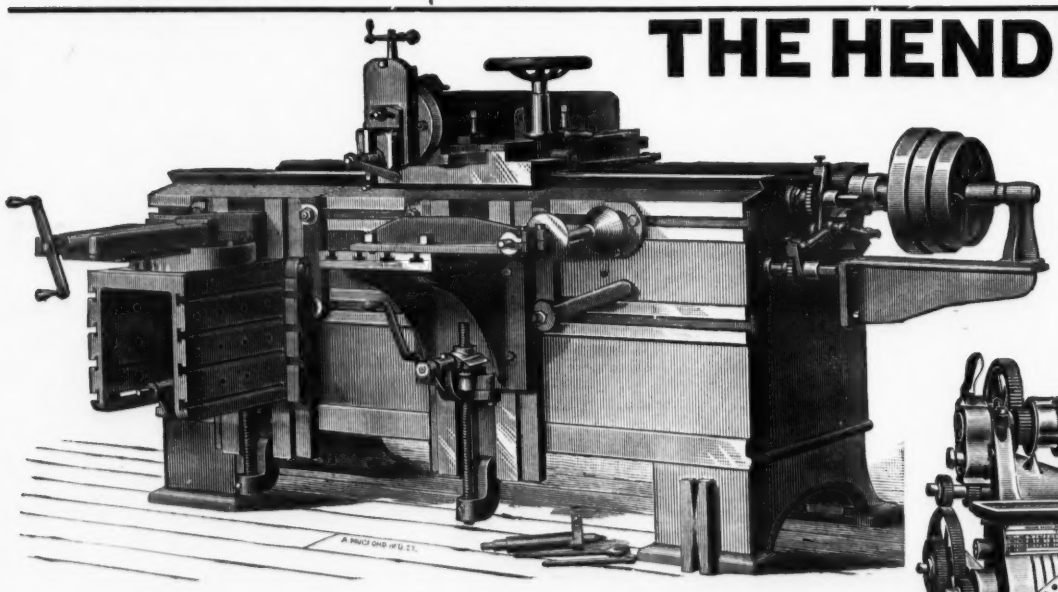

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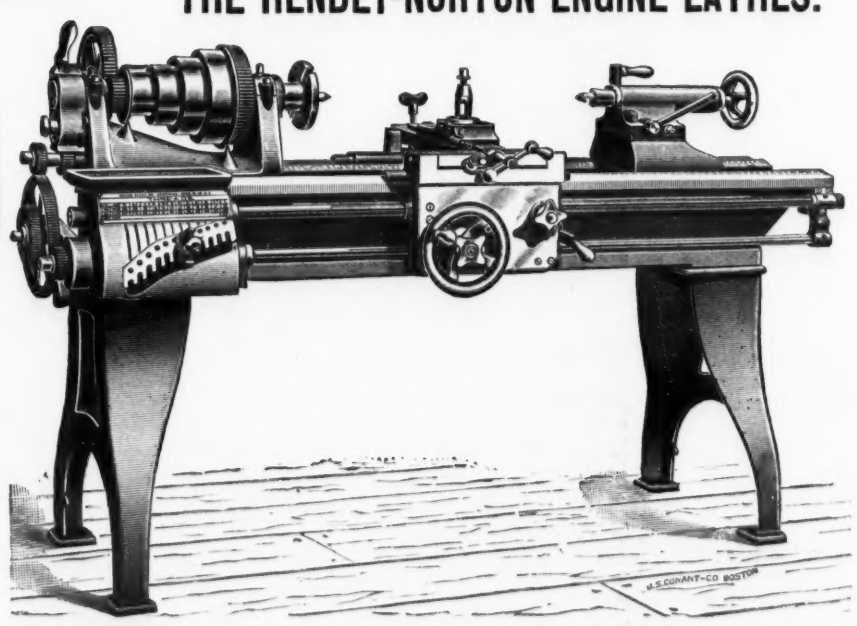

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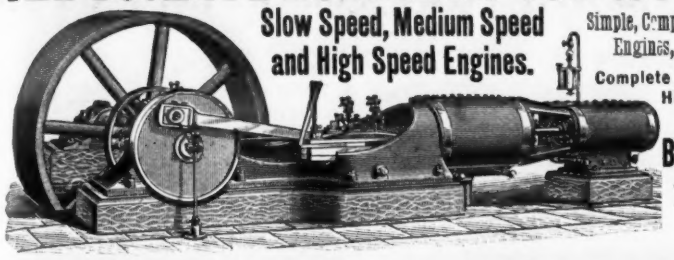

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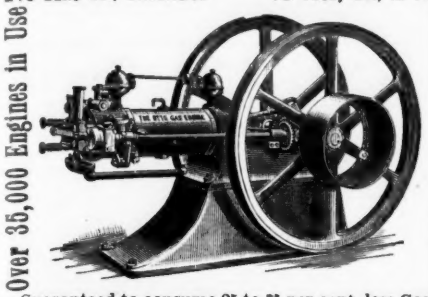

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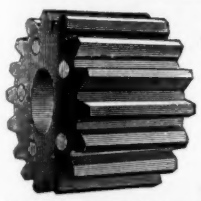

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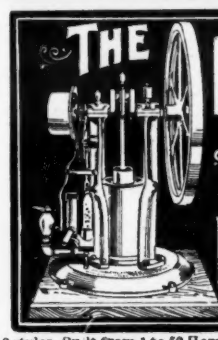

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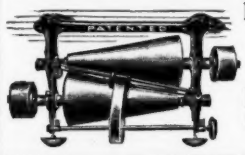

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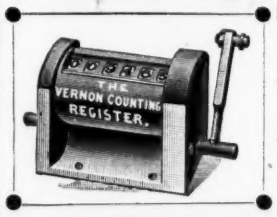

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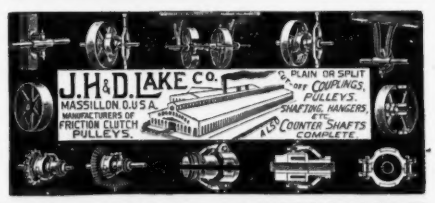

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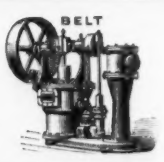

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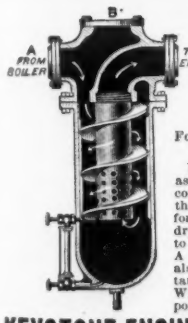

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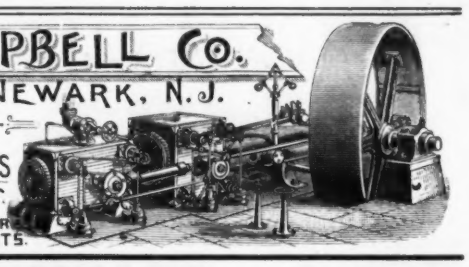

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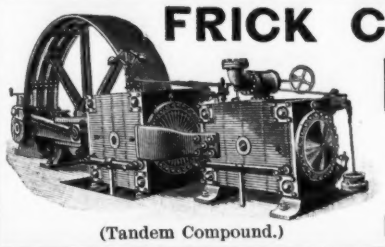

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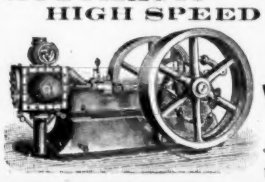

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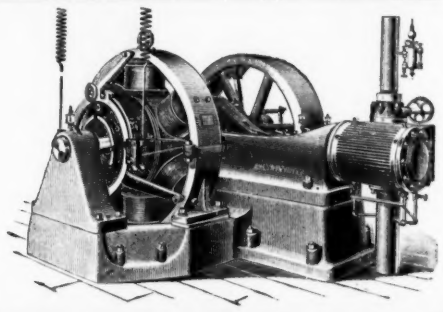

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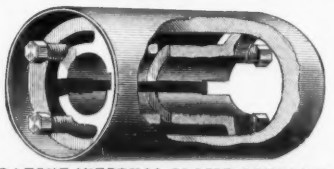

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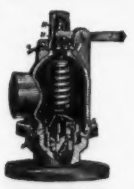

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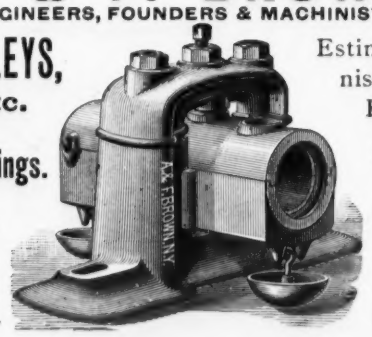

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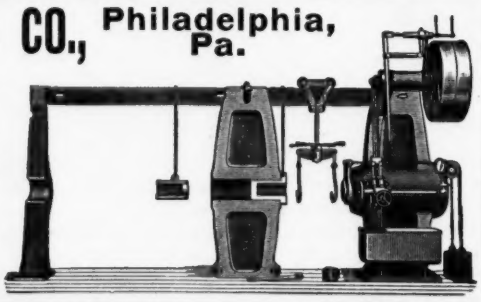

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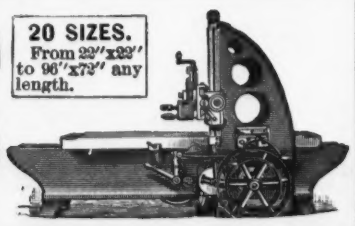

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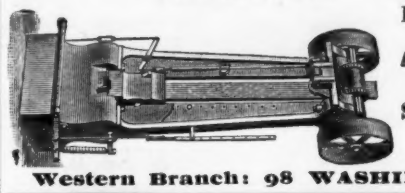

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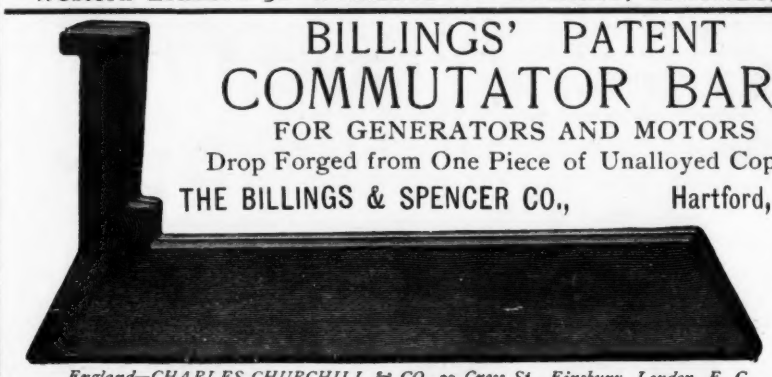

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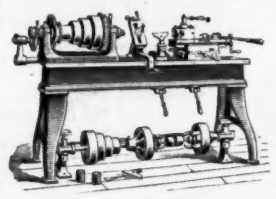

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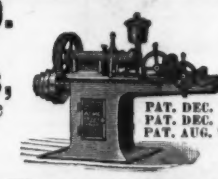

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